No. 8248

JVC Service Manual

MODEL HR-7600MS

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Important Safety Precautions

Prior to shipment from the factory, JVC products are strictly inspected to conform with the recognized product safety and electrical codes of the countries in which they are to be sold. However, in order to maintain such compliance, it is equally important to implement the following precautions when a set is being serviced.

● Precautions during Servicing

1. Locations requiring special caution are denoted by labels and inscriptions on the cabinet, chassis and certain parts of the product. When performing service, be sure to read and comply with these and other cautionary notices appearing in the operation and service manuals.

2. Parts identified by the ⚠ symbol and shaded (▨) parts are critical for safety.
   Replace only with specified part numbers.
   Note: Parts in this category also include those specified to comply with X-ray emission standards for products using cathode ray tubes and those specified for compliance with various regulations regarding spurious radiation emission.

3. Use specified internal wiring. Note especially:
   1) Wires covered with PVC tubing
   2) Double insulated wires
   3) High voltage leads

4. Use specified insulating materials for hazardous live parts. Note especially:
   1) Insulation Tape
   2) PVC tubing
   3) Spacers
   4) Insulation sheets for transistors

5. When replacing AC primary side components (transformers, power cords, noise blocking capacitors, etc.) wrap ends of wires securely about the terminals before soldering.

6. Observe that wires do not contact heat producing parts (heatsinks, oxide metal film resistors, fusible resistors, etc.)

7. Check that replaced wires do not contact sharp edged or pointed parts.

8. When a power cord has been replaced, check that 10–15 kg of force in any direction will not loosen it.

9. Also check areas surrounding repaired locations.

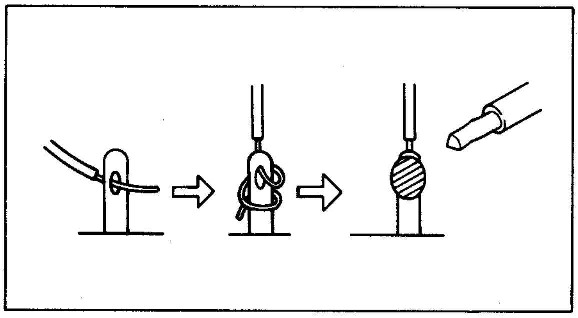


Fig. 1

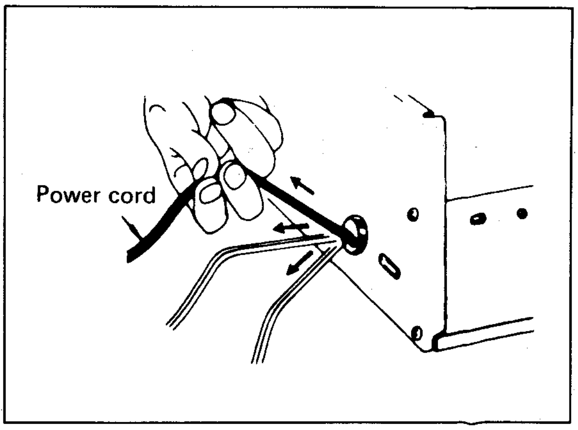


Fig. 2

10. Products using cathode ray tubes (CRTs)
    In regard to such products, the cathode ray tubes themselves, the high voltage circuits, and related circuits are specified for compliance with recognized codes pertaining to X-ray emission. Consequently, when servicing these products, replace the cathode ray tubes and other parts with only the parts specified. Under no circumstances attempt to modify these circuits. Unauthorized modification can increase the high voltage value and cause X-ray emission from the cathode ray tube.

11. Crimp type wire connector

In such cases as when replacing the power transformer in sets where the connections between the power cord and power transformer primary lead wires are performed using crimp type connectors, if replacing the connectors is unavoidable, in order to prevent safety hazards, perform carefully and precisely according to the following steps.

1. Connector part number : E03830-001
2. Required tool : Connector crimping tool of the proper type which will not damage insulated parts.
3. Replacement procedure
   1) Remove the old connector by cutting the wires at a point close to the connector.
      Important : Do not reuse a connector (discard it).
   2) Strip about 15 mm of the insulation from the ends of the wires. If the wires are stranded, twist the strands to avoid frayed conductors.
   3) Align the lengths of the wires to be connected. Insert the wires fully into the connector.
   4) As shown in Fig. 6, use the crimping tool to crimp the metal sleeve at the center position. Be sure to crimp fully to the complete closure of the tool.
   5) **Check the four points noted in Fig. 7.**

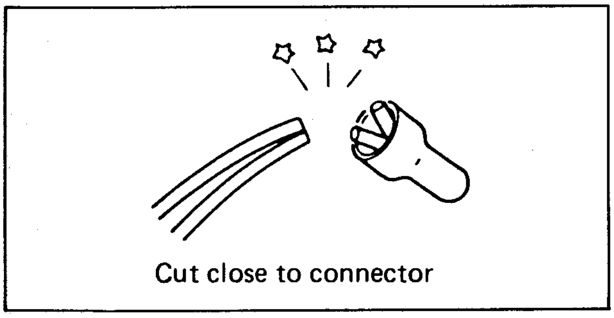

Cut close to connector

Fig. 3

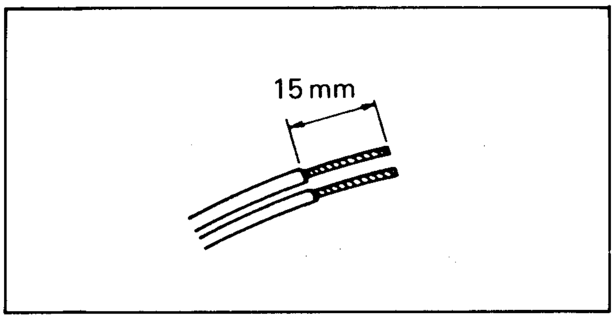


Fig. 4

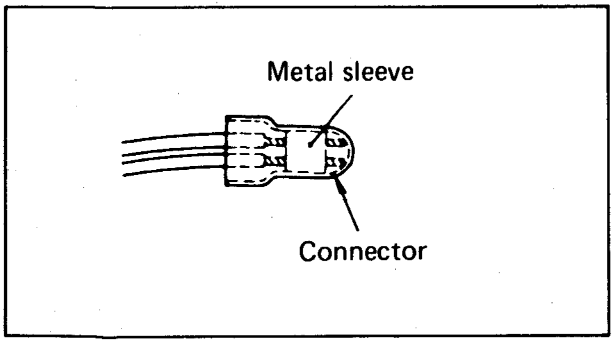

Metal sleeve
Connector

Fig. 5

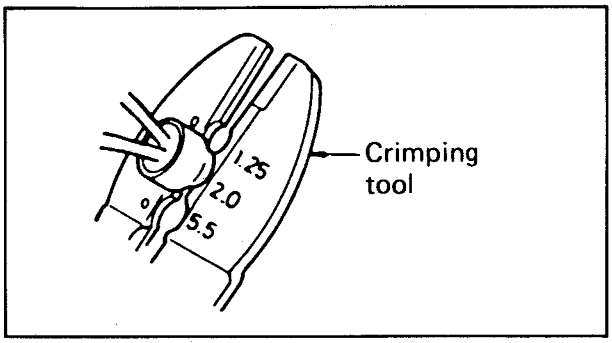

1.25
2.0
5.5
Crimping tool

Fig. 6

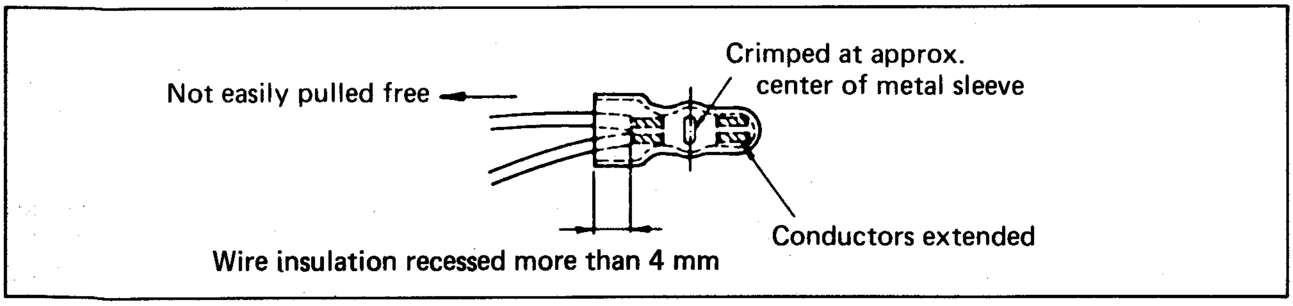

Not easily pulled free
Crimped at approx. center of metal sleeve
Conductors extended
Wire insulation recessed more than 4 mm

Fig. 7

● Safety Check after Servicing

Examine the area surrounding the repaired location for damage or deterioration. Observe that screws, parts and wires have been returned to original positions. Afterwards, perform the following tests and confirm the specified values in order to verify compliance with safety standards.

1. **Insulation resistance test**
   Confirm the specified insulation resistance or greater between power cord plug prongs and externally exposed parts of the set (RF terminals, antenna terminals, video and audio input and output terminals, microphone jacks, earphone jacks, etc.). See table below.

2. **Dielectric strength test**
   Confirm specified dielectric strength or greater between power cord plug prongs and exposed accessible parts of the set (RF terminals, antenna terminals, video and audio input and output terminals, microphone jacks, earphone jacks, etc.) See table below.

3. **Clearance distance**
   When replacing primary circuit components, confirm specified clearance distance (d),(d') between soldered terminals, and between terminals and surrounding metallic parts. See table below.

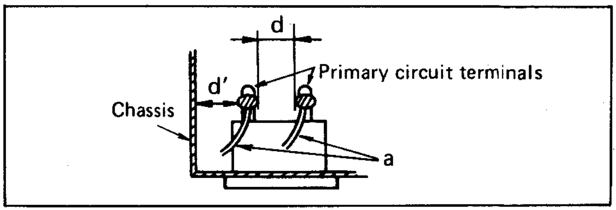


Fig. 8

Table 1: Ratings for selected areas

AC Line Voltage	Region	Insulation Resistance	Dielectric Strength	Clearance Distance(d),(d')
100 V	Japan	≧ 1 MΩ/500 V DC	1 kV 1 minute	≧ 3 mm
110 to 130 V	USA & Canada	– – –	900 V 1 minute	≧ 3.2 mm
* 110 to 130 V 200 to 240 V	Europe Australia	≧ 10 MΩ/500 V DC	4 kV 1 minute	≧ 6 mm (d) ≧ 8 mm (d') (a: Power cord)

* Class II model only.

Note. This table is unofficial and for reference only. Be sure to confirm the precise values for your particular country and locality.

4. **Leakage current test**
   Confirm specified or lower leakage current between B(earth ground, power cord plug prongs) and externally exposed accessible parts (RF terminals, antenna terminals, video and audio input and output terminals, microphone jacks, earphone jacks, etc.).

Measuring Method: (Power ON)
Insert load Z between B(earth ground,power cord plug prongs) and exposed accessible parts. Use an AC voltmeter to measure across both terminals of load Z. See figure and following table.

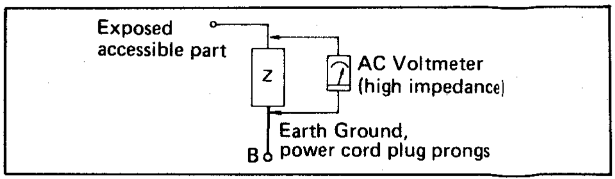
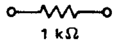
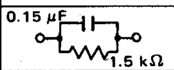
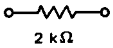
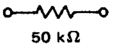

Exposed accessible part
Z
AC Voltmeter (high impedance)
Earth Ground, power cord plug prongs
B

Fig. 9

Table 2: Leakage current ratings for selected areas

AC Line Voltage	Region	Load Z	Leakage Current (i)	Earth Ground (B) to:
100 V	Japan	 1 kΩ	i ≦ 1m A rms	Exposed accessible parts
110 to 130 V	USA & Canada	 0.15 μF 1.5 kΩ	i ≦ 0.5m A rms	Exposed accessible parts
110 to 130 V 200 to 240 V	Europe Australia	 2 kΩ	i ≦ 0.7 m A peak i ≦ 2 m A dc	Antenna earth terminals
		 50 kΩ	i ≦ 0.7 m A peak i ≦ 2 m A dc	Other terminals

Note. This table is unofficial and for reference only. Be sure to confirm the precise values for your particular country and locality.

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8 . 2 . 31 Mix Booster Board Ass'y 8-34
8 . 2 . 32 Video Sub Board Ass'y 8-35
8 . 2 . 33 Servo Power Transistor Board 8-36
8 . 2 . 34 Remote Control Board Ass'y 8-36

HR-7600MS

INSTRUCTIONS

For reference, the text of the instruction booklet of this model is reproduced in the following pages.
Numbering of the pages also corresponds with that of the booklet.

Thank you for purchasing the JVC HR-7600MS Video Cassette Recorder. This unit conforms to the VHS video format developed for full home entertainment by JVC to provide high-quality recording and playback capability.

Besides the full complement of the most advanced features currently available, the HR-7600MS incorporates the circuitry required to record or play back the PAL, SECAM, or NTSC signals from any television broadcasting system in the world.

To obtain the best results and avoid malfunctions, please read this instruction booklet carefully and thoroughly before using your HR-7600MS.

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Features 3
Precautions 3
Important information on colour system selection . . . 4
General description of controls, indicators and connectors 8

Part II Preparations

How to connect the HR-7600MS to your TV set 13
How to set your video channel 14
How to pre-tune the built-in tuner 15
How to set the clock 17

Part III Basic operation

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How to record one TV programme while watching another 20
How to record a TV programme from a monitor-receiver 20
How to play back the video cassette 21
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VHS
PAL SECAM NTSC

Only cassettes marked VHS can be used with this video cassette recorder.

WARNING:
TO PREVENT FIRE OR SHOCK HAZARD, DO NOT EXPOSE THIS UNIT TO RAIN OR MOISTURE.

CAUTION

Dangerous voltage inside. Refer internal servicing to qualified service personnel. To prevent electric shock or fire hazard, remove the power cord from the AC outlet prior to connecting or disconnecting any signal lead or aerial, prior to replacing the fuse, and prior to altering the voltage setting.

POWER SYSTEM

Connection to the mains supply

The operating voltage of this set is preset to 220 V ∿ at the factory.

Before connecting to mains, check that the voltage selector on the rear panel is set to the same voltage as your local mains supply.

Adapting to local power line

This set operates on either 110, 127, 220 or 240 V∿.

If the preset voltage is different from the power line voltage in your area, reset the voltage selector by inserting a screwdriver into the slot of the voltage selector and turning it until the correct voltage is displayed.

POWER SWITCH

The mains switch is located on the rear connector panel. Setting this switch to OFF removes all applied power from the set including the timer clock. Switching on or off the recorder section is performed with the secondary power switch on the front panel, which has three positions labelled "TIMER", "ON" and "OFF" (referred to as "sub-power switch").

IMPORTANT: It is permissible to record television programmes only in the event that third party copyrights and other rights are not violated.

NOTE: The rating plate and the safety caution are on the rear of the unit.

STRUCTURE OF THIS MANUAL

Your new HR-7600MS may be somewhat complicated to operate at first because of its highly advanced features. In order to help you master the operation of this unit, this booklet is divided into six parts. The ideas and contents of each part are described here. So first read this page and then you can start referring to any part depending on your situation.

PART I: GENERAL DESCRIPTION

This introduction to your new machine contains the handling precautions you must observe to be assured of safe operation, and a concise list of the HR-7600MS features and capabilities. Also included is a guide to selecting the appropriate circuitry for the braodcasting standard in your area, or the type of camera or tape you're using. For quick reference as you read the rest of this booklet, you will also find detailed drawings and a brief explanation of all controls and connectors.

FEATURES 3
PRECAUTIONS 3
IMPORTANT INFORMATION ON COLOUR SYSTEM SELECTION 4
GENERAL DESCRIPTION OF CONTROLS, INDICATORS AND CONNECTORS 8

PART II: PREPARATIONS

All that you have to do before actual use of this machine is described in Part II. First you have to connect this recorder to your TV set. Then you must pre-tune the built-in tuner to specific stations in your area. Also, since this unit has a built-in timer which also functions as an ordinary clock, you may wish to set it to the correct time, even though you are still not going to use its timer facility.

HOW TO CONNECT THE HR-7600MS TO YOUR TV SET 13
HOW TO SET YOUR VIDEO CHANNEL 14
HOW TO PRE-TUNE THE BUILT-IN TUNER 15
HOW TO SET THE CLOCK 17

PART III: BASIC OPERATION

After the preparations, you are ready to record a TV programme while watching it or watching another one on a different channel, and then play back the recorded tape at any convenient time. This is the basic function of any deck-type video recorder. Although this machine is full of convenient features, the first step to familiarize yourself with the working principle of this machine may be to master this procedure. With this in mind, this section is devoted to step-by-step explanation of this basic operation, beginning with "how to insert a cassette".

HOW TO LOAD AND UNLOAD THE VIDEO CASSETTE 18
HOW TO RECORD A TV PROGRAMME WHILE WATCHING IT 19
HOW TO RECORD ONE TV PROGRAMME WHILE WATCHING ANOTHER 20
HOW TO RECORD A TV PROGRAMME FROM A MONITOR-RECEIVER 20
HOW TO PLAY BACK THE VIDEO CASSETTE 21
HOW TO ENJOY VARIABLE-SPEED PLAYBACK . . . 22

PART IV: ADVANCED USAGE

One big feature of the HR-7600MS is its timer recording facility. You can reserve recordings at any time within two weeks in advance for as much as eight TV programmes either individually, in series or in weekly repetitions.

Also, since the HR-7600MS is provided with a camera connector, JVC video cameras can be directly connected to make your own video movies easily. Its audio dubbing facility enables replacing the recorded sound with another sound track of your choice. If you are ready to fully utilize these facilities, refer to part IV.

HOW TO PRESET THE TIMER FOR UNATTENDED RECORDING 23
HOW TO SET THE RECORDER FOR UNATTENDED RECORDING 24
FOR A BETTER UNDERSTANDING OF THE PROGRAMMABLE TIMER 25
HOW TO USE THE SLEEP TIMER FACILITY 26
HOW TO RECORD WITH A VIDEO CAMERA 27
HOW TO PERFORM AUDIO DUBBING 28
HOW TO PERFORM INSERT EDITING 29

PART V: ADDITIONAL FACILITIES

This is a cross-reference chapter which contains detailed description of several convenient facilities such as the cue and counter search functions for tape indexing, etc. These functions are briefly mentioned in other parts of this booklet when needed. However, refer to Part V whenever you wish to know the details of these functions, following the cross-reference indications.

Another subject of this section is the infrared remote control unit. Since most buttons on the remote control unit function in the same way as the corresponding buttons on the recorder, there may be no problem in using it. However, necessary precautions are mentioned in this section, so please refer to it before you start using the remote control unit.

HOW TO USE THE TAPE COUNTER 31
HOW TO USE THE SEARCH SWITCH 31
HOW TO USE THE TRACKING CONTROL 31
HOW TO USE THE REMOTE CONTROL UNIT 32

PART VI: SUPPLEMENTS

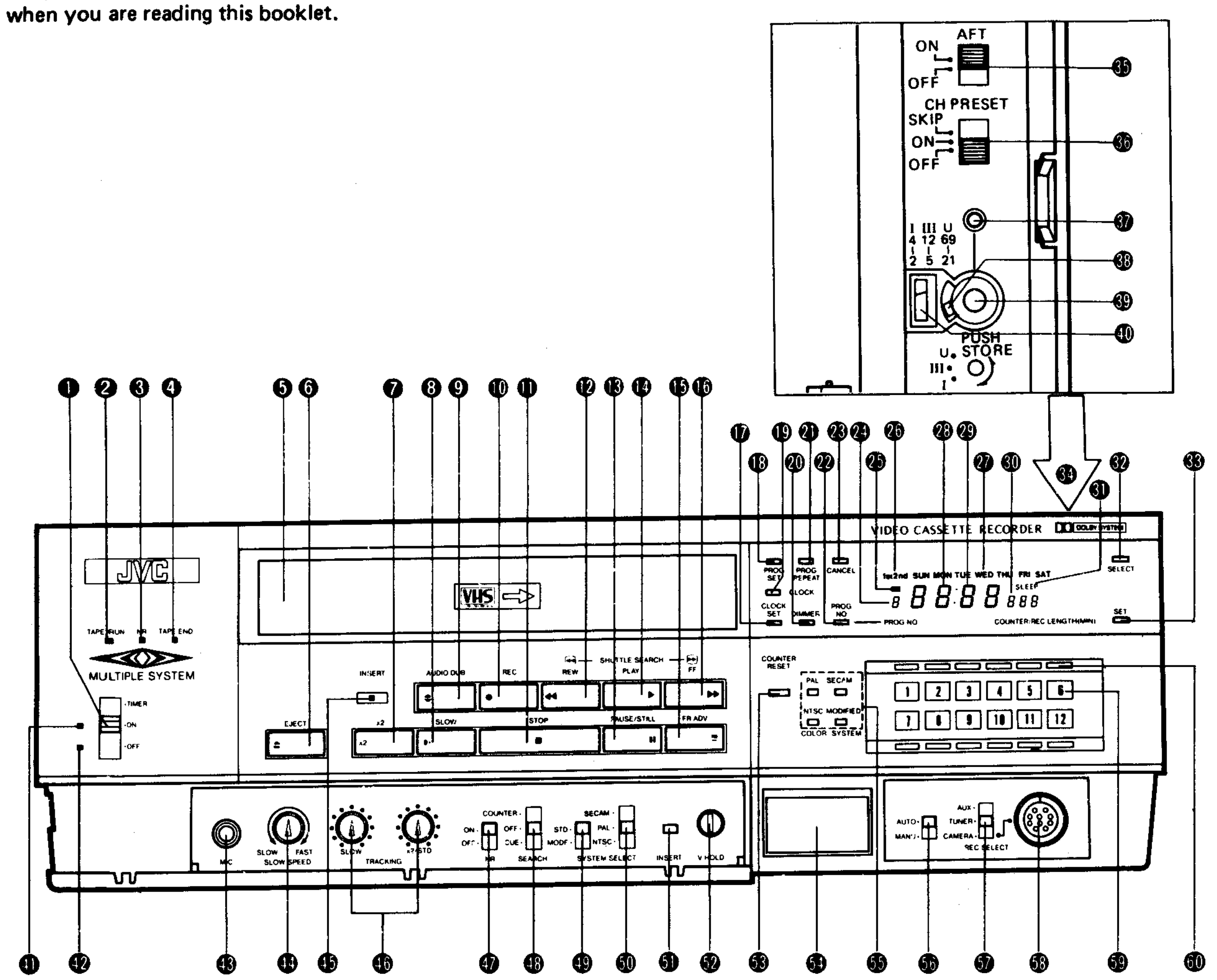
A simple troubleshooting guide, hints for maintenance and countermeasures for some problems with pictures on the TV screen are put together in this section. When you encounter some strange phenomena in using the HR-7600MS, reference to Part VI may help you.

ADJUST YOUR TV RECEIVER WHEN 33
HEAD CLEANING 33
IN CASE OF DIFFICULTY 34
SPECIFICATIONS 34

PART I

GENERAL DESCRIPTION

Keep this page opened so that you can refer to it at any time when you are reading this booklet.



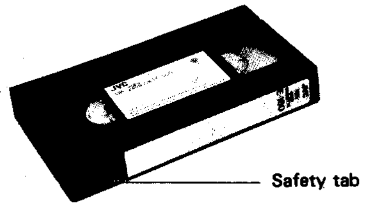
FEATURES

- PAL, SECAM and NTSC recording and playback circuitry.
- Motorized front-loading cassette system.
- Infrared remote control unit.
- Microprocessor-based, fully electronic logic control system.
- Shuttle search function for quick location of a particular segment in both forward and reverse directions (at about 9 times normal speed with PAL/SECAM tapes and about 7 times normal speed with NTSC tapes.)
- Variable-speed playback in double-speed, slow-motion, freeze-frame and frame-advance modes.
- Fluorescent tube display for indicating tape counting, clock time and programmed timer recording data.
- Multi-programmable timer for presetting up to 8 programmes within a 14-day period.
- Clock/timer memory hold system with a back-up time of about 10 minutes.
- Automatic edit control system which operates on the principle of back-space editing minimizes picture distortion between separately recorded segments.
- Simplified insert editing function which permits different programme segments to be inserted on a pre-recorded tape with minimized distortion at both the start and end of the new, added material.
- Newly-developed brushless, quartz-locked direct-drive drum motor plus motors for capstan, reel, cassette loading and tape loading provide greater stability and higher reliability.
- Simplified mechanism and improved performance in addition to stable tape transport and easy alignment via five-motor system.
- 12-Channel pre-tunable electronic tuner with automatic channel lock mechanism.
- Built-in Dolby* noise reduction system for improved sound quality.
- Advanced mechanisms including cue and counter search for speedy location of a specific programme and tape-end automatic rewind.
- Tape-end indicator warning in two steps.
- Direct camera connection to the front panel connector.
- Sleep timer facility for recording.
- Improved clock accuracy through use of a quartz oscillator.
- Dimmer control for the entire fluorescent display.
- Tape-run indicator.
- Simplified tuning system.

PRECAUTIONS

Handling and storage

- Avoid using the HR-7600MS under the following conditions:
  - extremely hot, cold or humid places,
  - dusty places,
  - near appliances generating strong magnetic fields,
  - places subject to vibrations, and
  - poorly ventilated places.
- Be careful of moisture condensation.
  Avoid using the HR-7600MS immediately after moving from a cold place to a warm place or soon after heating a room which was cold. The water vapor in warm air will condense on the still-cold video head drum and tape guides and may cause damage to the tape and the recorder.
- Handle the HR-7600MS carefully.
  - Do not block the ventilation openings.
  - Do not place anything heavy on the recorder.
  - Do not place anything which might spill and cause trouble on the top cover of the recorder.
  - Use in horizontal (flat) position only.
- In case of transportation,
  - Avoid violent shocks to the recorder during packing and transportation.
  - **Before packing, be sure to remove the cassette from the recorder.**



Video cassettes

- The HR-7600MS employs VHS-type cassettes only.
  E-240 for 4 hours, E-180 for 3 hours, E-120 for 2 hours, E-60 for 1 hour and E-30 for 30 minutes of PAL or SECAM recording. T-160 for 2 hours and 40 minutes, T-120 for 2 hours, T-60 for 1 hour and T-30 for 30 minutes of NTSC recording.
- Video cassettes are equipped with a safety tab to prevent accidental erasure. When the tab is removed, recording cannot be performed. If you wish to record on a cassette whose tab has already been removed, use adhesive tape to block the hole.
- Avoid exposing the cassettes to direct sunlight. Keep them away from heaters.
- Avoid extreme humidity, violent vibrations or shocks, strong magnetic fields (near a motor, transformer or magnet) and dusty places.
- Place the cassettes in cassette cases and position vertically.

Moisture condensation

- If you pour a cold liquid into a glass, water vapor in the air will condense on the surface of the glass. This is called moisture condensation.
- Moisture condensation on the head drum, one of the most crucial parts of the HR-7600MS, will cause damage to the tape.
- Moisture in the air will condense on the HR-7600MS when you move the unit from a cold place to a warm place, after heating a cold room or under extreme humidity conditions.
- The HR-7600MS is equipped with a moisture condensation prevention circuit which automatically heats the head drum according to the ambient temperature. This circuit operates only when the unit is plugged into an AC outlet, the rear panel MAINS POWER switch is set to ON and the front panel sub-power switch is set to OFF.
- The moisture condensation prevention circuit consumes only a slight amount of power. However, if for some reason you are not using the HR-7600MS for a long period of time, it is advisable to remove the power cord from the AC outlet or set the rear panel MAINS POWER switch to OFF.
- Since the moisture condensation prevention circuit cannot evaporate existing moisture condensation immediately after the power cord has been plugged into the AC outlet, you must allow for about 2 hours if the HR-7600MS is to be used in such areas as would occasion moisture condensation.

Operation

- The cassette can be loaded only when the recorder is powered (with the front panel sub-power switch set to ON). Do not force the cassette into the slot with the power off.
- When the rear panel MAINS POWER switch is set to ON after it has been set to OFF once, the recorder section cannot be powered even though the front panel sub-power switch has been in the ON position. In such a case, first set the sub-power switch to OFF and then set it to ON.
- If you wish to operate the recorder locally after you have switched the power off via the remote control unit, first set the sub-power switch to OFF and then set it to ON again.
- As long as the sub-power switch is set to ON, switching the recorder on or off can be performed via the remote control unit.

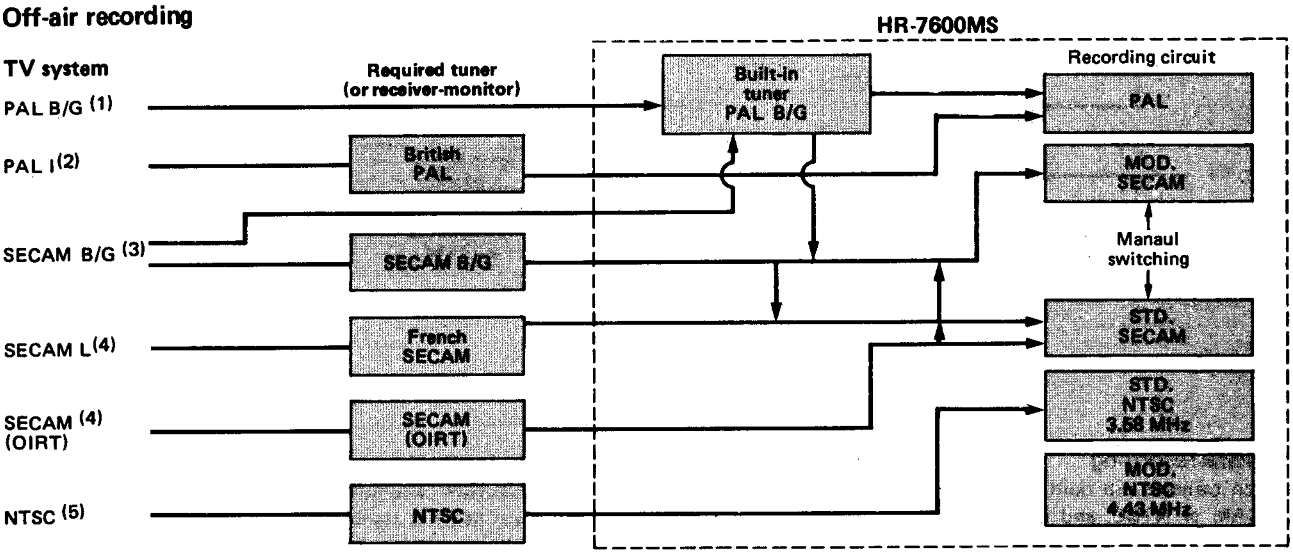
Remote control unit

- Avoid violent shocks, especially take care not to drop the unit.
- Take care not to allow liquid to spill into the unit.
- Do not place heavy objects on the unit, especially be careful not to step on it.
- Avoid leaving the unit in places subject to direct sunlight or extremely high temperatures.

IMPORTANT INFORMATION ON COLOUR SYSTEM SELECTION

The HR-7600MS incorporates the circuitry necessary to record or play back the PAL, SECAM or NTSC signals from any television broadcasting system in the world. To select the right colour system, there are three switches on the HR-7600MS; AUTO/MANU master SYSTEM SELECT switch (56), SECAM/PAL/NTSC switch ㊿ and STD/MOD switch ㊾. Generally, when the master switch is set to AUTO, the appropriate system is selected according to the input signal. However, some situations require manual switching. (The circuit in operation is indicated by the 4 COLOUR SYSTEM indicators (55).) Please read carefully the following information to ensure correct recording and playback.

Off-air recording



Off-air recording

As illustrated above, the HR-7600MS incorporates 5 different recording circuits to process PAL, MOD. SECAM, STD. SECAM, STD. NTSC and MOD. NTSC signals, enabling broadcasts in any country to be recorded. However, its built-in tuner is for receiving PAL (B/G) broadcasts; to record off the air in countries where television systems other than the PAL (B/G) are employed, it is necessary to connect a tuner (or monitor-receiver) of the corresponding standard.

(1) PAL B/G broadcasts

PAL B/G is the colour television broadcasting system used in most Continental European countries (except France, Luxemburg, and Monaco) and some countries of the Middle East, Africa and Asia. The built-in tuner can be used to record off the air in these countries. Simply set the master SYSTEM SELECT switch to AUTO.

(2) PAL I broadcasts

PAL I is the colour television broadcasting system frequently identified as the British PAL system and used in England, Ireland and some African countries. To record off the air in these countries, a tuner (or monitor-receiver) built to the British PAL system is necessary. The setting of the SYSTEM SELECT switches is identical to that for PAL B/G.

(3) SECAM B/G broadcasts

SECAM B/G is the colour television broadcasting system employed in many countries of the Middle East and Africa. Although SECAM B/G broadcasts can be recorded through a separate tuner (or monitor-receiver) built to this standard, the HR-7600MS's built-in tuner functions sufficiently to receive these broadcasts. Depending on the setting of the STD/MOD switch, either a standard SECAM or modified SECAM tape can be made. Set this switch manually to the appropriate position even when the master SYSTEM SELECT switch is set to AUTO.

(4) SECAM L and SECAM (OIRT) broadcasts

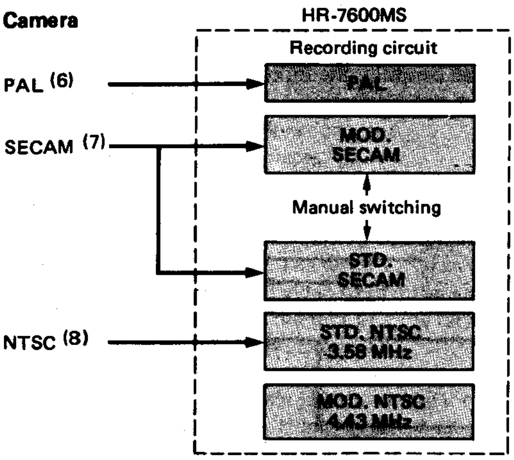
SECAM L is usually identified as the French SECAM system and is employed in France and a few other countries, and the SECAM (OIRT) system is the colour television system of the majority of Eastern European countries. To record off the air in these countries, a tuner (or monitor-receiver) of the corresponding standard is necessary. Both modified SECAM and standard SECAM circuits are involved; select the appropriate position of the STD/MOD switch, even when the master SYSTEM SELECT switch is set to AUTO.

(5) NTSC broadcasts

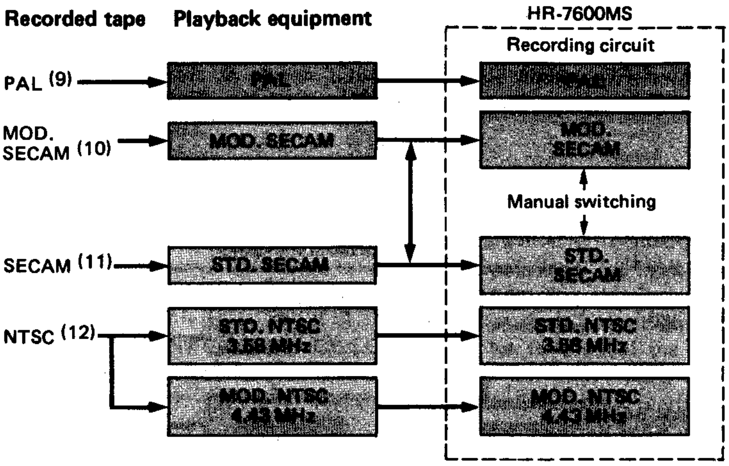
NTSC is the colour television broadcasting system used in the USA, Canada, Japan, several Latin American countries and a few Asian countries. To record off the air in these countries, a tuner (or monitor-receiver) of the NTSC standard is necessary. The broadcast NTSC signal has a subcarrier frequency of 3.58 MHz. Therefore, in the AUTO mode, the standard NTSC circuit is automatically selected.

For further information, consult your nearest JVC dealer.

Camera recording


Camera
HR-7600MS
Recording circuit
PAL (6)
SECAM (7)
NTSC (8)
PAL
MOD. SECAM
Manual switching
STD. SECAM
STD. NTSC 3.58 MHz
MOD. NTSC 4.43 MHz

Tape-to-tape transfer


Recorded tape
Playback equipment
HR-7600MS
Recording circuit
PAL (9)
MOD. SECAM (10)
SECAM (11)
NTSC (12)
PAL
MOD. SECAM
STD. SECAM
STD. NTSC 3.58 MHz
MOD. NTSC 4.43 MHz
MOD. SECAM
Manual switching
STD. SECAM
STD. NTSC 3.58 MHz
MOD. NTSC 4.43 MHz

Camera recording

Video cameras are built to one of the three standards; PAL, SECAM or NTSC, and deliver different signals depending on the standard. To produce tapes with normally recorded signals, use the AUTO mode or set the SYSTEM SELECT switches correctly. For instance, it is impossible to produce NTSC tapes with a PAL camera by manually selecting the NTSC circuit.

(6) PAL cameras
Setting the master SYSTEM SELECT switch to AUTO is sufficient in most cases.

(7) SECAM cameras
Either standard or modified SECAM tapes can be produced, depending on the switch positions.

(8) NTSC cameras
Engaging the AUTO mode automatically selects the standard NTSC circuit.

Tape-to-tape transfer

There are 4 different types of recorded tape, depending on the signal recorded.

(9) PAL tapes
To transfer PAL tapes, a second recorder built to the PAL standard is required to play them. Switch positions are identical to those for recording PAL broadcasts and from a PAL camera.

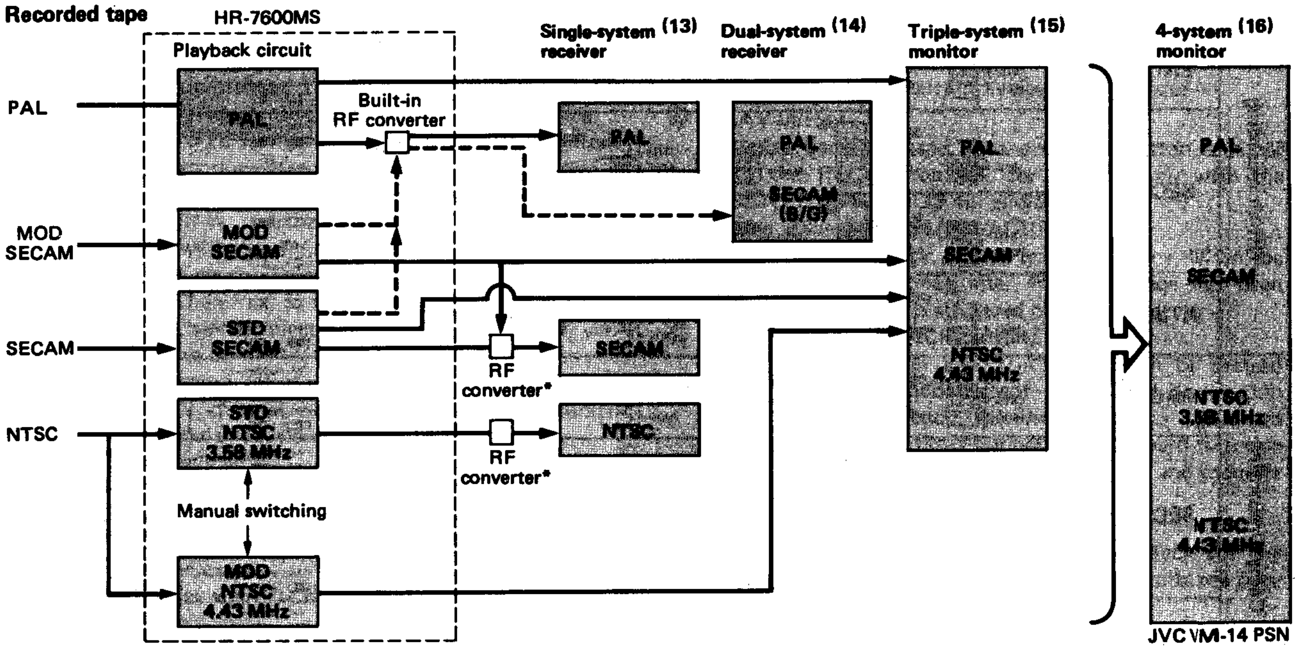
(10) Modified SECAM tapes
Use playback equipment which is capable of processing modified SECAM signals. Depending on what type of tape is desired, either the modified SECAM or standard SECAM circuit of the HR-7600MS can be used. Set the STD/MOD switch manually as required.

(11) Standard SECAM tapes
Use playback equipment which is capable of handling standard SECAM signals. Depending on what type of tape is desired, either the modified SECAM or standard SECAM circuit of the HR-7600MS can be used. Set the STD/MOD switch manually as required.

(12) NTSC tapes
If the playback equipment is built to the NTSC 3.58 MHz standard, the standard NTSC circuit is automatically selected in the AUTO mode. Likewise, if the playback equipment is built to the NTSC 4.43 MHz standard, the modified NTSC circuit is automatically selected in the AUTO mode.

CAUTION
When the HR-7600MS is connected to a multi-system television set, it may happen that no colours appear on the screen if the colour system select switch of the television set is adjusted to the AUTO position. In such a case, change the setting of the colour system select switch of the television set to an appropriate position.

Playback


Recorded tape
HR-7600MS
Playback circuit
PAL
MOD SECAM
SECAM
NTSC
PAL
Built-in RF converter
MOD SECAM
STD SECAM
STD NTSC 3.58 MHz
Manual switching
MOD NTSC 4.43 MHz
RF converter*
RF converter*
Single-system (13) receiver
PAL
SECAM
NTSC
Dual-system (14) receiver
PAL SECAM (B/G)
Triple-system (15) monitor
PAL
SECAM
NTSC 4.43 MHz
4-system (16) monitor
PAL
SECAM
NTSC 3.58 MHz
NTSC 4.43 MHz
JVC VM-14 PSN

Playback

The chart for playback and monitoring is separate from the charts for recording. As mentioned above, there are 4 different types of recorded tape. To view video tapes, you may use a TV receiver, or a monitor-receiver or a video monitor, each of which may be built to a specific standard or combination of standards. The chart shows most typical ones of them.

(13) Single-system receiver

Basically, a single-system receiver (or video monitor) enables tapes of the corresponding system to be viewed. The built-in RF converter of the HR-7600MS is built to the PAL system; therefore, to view tapes using a SECAM or NTSC receiver, the built-in RF converter must be replaced with one of the corresponding standard. In such cases, consult a JVC dealer.

Switch positions are identical to those for recording PAL, SECAM or NTSC signals respectively.

(14) PAL/SECAM (B/G) dual-system receiver

Owners of this type of receiver, mostly available in the Middle East, can view PAL and SECAM (both modified and standard) tapes with the built-in RF converter.

(15) PAL/SECAM/NTSC 4.43 MHz video monitor

All tapes can be viewed with this type of monitor. Even in the AUTO mode, select the MOD position of the STD/MOD switch when viewing NTSC tapes.

(16) 4-system video monitor

All tapes can be viewed in the AUTO mode.

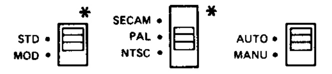
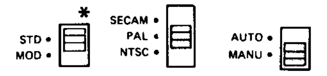
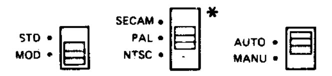
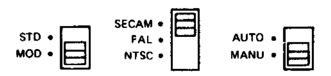
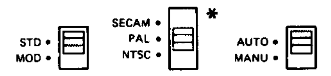
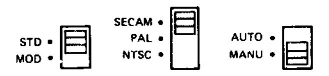
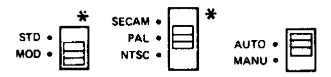
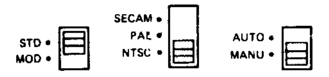
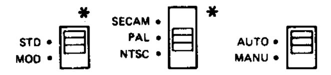
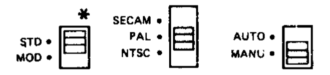
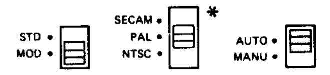
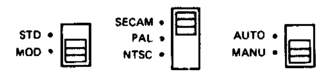
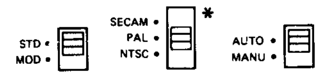
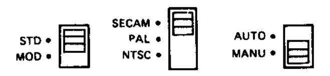
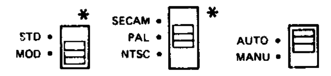
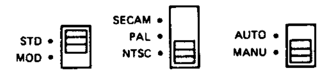
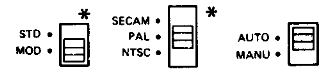
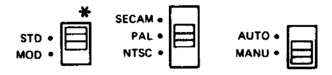
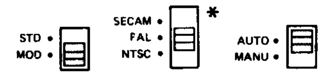
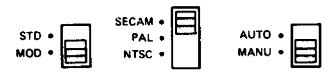
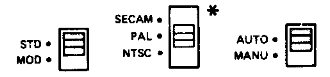
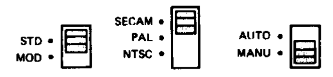
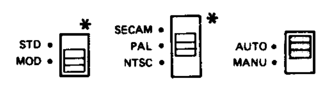
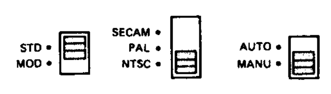
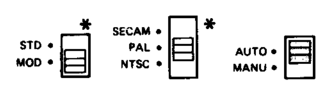
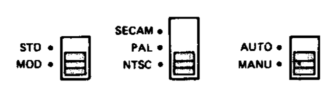
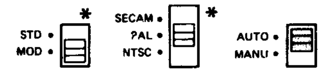
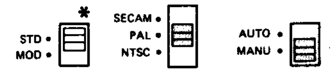
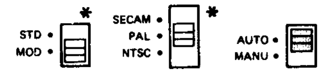
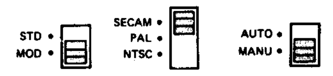
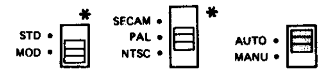
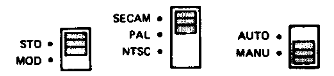
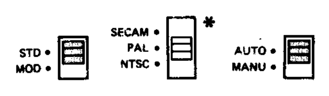
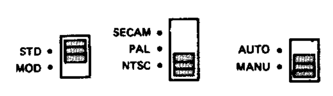
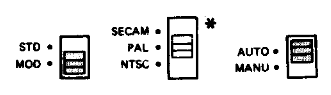
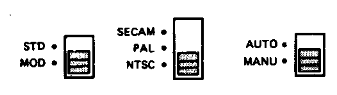
*Consult a JVC dealer.

SYSTEM SELECT switches and indicators

(Refer to the chart on the next page.)

- When the master SYSTEM SELECT switch is set to AUTO, the HR-7600MS reads the input signal (or taped signal during playback) and automatically activates the necessary circuit. For MOD SECAM or STD SECAM only, set the STD/MOD switch as required for recording. For playback of NTSC tapes, select the correct position of the STD/MOD switch, depending on the system of the monitor used.
- In the AUTO mode, the indicator corresponding to the automatically selected system lights.
- When the master SYSTEM SELECT switch is set to MANU, the selected circuit is activated regardless of the input signal. The indicator shows the switch positions.
- While recording in the AUTO mode, if the input signal is unstable, substandard or interrupted, the lighted indicator starts flashing.
- If there is no input signal at the initial stage of recording in the AUTO mode, the MANU mode is forcedly engaged and the system corresponding to the switch positions is activated, causing the corresponding indicator to flash.
- NTSC tapes recorded in the LP (Long Play) or EP (Extended Play) mode cannot be played back on this unit. If playback is attempted with such a tape in the AUTO mode, the NTSC indicator will flash.
- In the MANU mode, no indicator flashes in any situation. Playback picture is the reference.
- With a B/W signal input, or when a B/W tape is played back in the AUTO mode, the PAL indicator will light with CCIR signals and the NTSC indicator will light with EIA signals (the MOD indicator will also light when the STD/MOD switch is set to MOD during playback of EIA monochrome tapes.)

SYSTEM SELECT switch positions & Indicators

Use	Source	SYSTEM SELECT switches		Indicators	Remarks
		AUTO mode	MANUAL mode		
Off-air recording	PAL			PAL ■ SECAM □ NTSC □ MODIFIED □	
	SECAM			PAL □ SECAM ■ NTSC □ MODIFIED ■	To produce modified SECAM tapes.
				PAL □ SECAM ■ NTSC □ MODIFIED □	To produce standard SECAM tapes.
	NTSC			PAL □ SECAM □ NTSC ■ MODIFIED □	
Camera recording	PAL			PAL ■ SECAM □ NTSC □ MODIFIED □	
	SECAM			PAL □ SECAM ■ NTSC □ MODIFIED ■	To produce modified SECAM tapes.
				PAL □ SECAM ■ NTSC □ MODIFIED □	To produce standard SECAM tapes.
	NTSC			PAL □ SECAM □ NTSC ■ MODIFIED □	
Tape-to-Tape transfer	PAL			PAL ■ SECAM □ NTSC □ MODIFIED □	
	SECAM			PAL □ SECAM ■ NTSC □ MODIFIED ■	To produce modified SECAM tapes.
				PAL □ SECAM ■ NTSC □ MODIFIED □	To produce standard SECAM tapes.
	NTSC (played on STD NTSC machine)			PAL □ SECAM □ NTSC ■ MODIFIED □	
	NTSC (played on MOD NTSC machine)			PAL □ SECAM □ NTSC ■ MODIFIED ■	
Playback	PAL			PAL ■ SECAM □ NTSC □ MODIFIED □	
	MOD SECAM			PAL □ SECAM ■ NTSC □ MODIFIED ■	
	STD SECAM			PAL □ SECAM ■ NTSC □ MODIFIED □	
	NTSC (to be viewed on 3.58 MHz monitor)			PAL □ SECAM □ NTSC ■ MODIFIED □	
	NTSC (to be viewed on 4.43 MHz monitor)			PAL □ SECAM □ NTSC ■ MODIFIED ■	

*The position of a switch so marked is irrelevant.

GENERAL DESCRIPTION OF CONTROLS, INDICATORS AND CONNECTORS

Front panel

① **Sub-power switch**
Set to ON when you use the recorder for recording or playback. Set to TIMER after you have preset the recorder for unattended timer recording, and the power will switch on automatically when the preset time is reached. Set to OFF when you switch off the power from the recorder section. When the switch is set to ON (with the REC SELECT switch (57) set to TUNER), the recorder's built-in tuner operates to receive off-the-air TV programmes, while the TV receiver's built-in tuner operates to receive off-the-air TV programmes when the switch is set to OFF. Therefore, in the former case, by setting the TV receiver channel selector to your video channel, you can see pictures on the TV screen that are chosen with the recorder's channel selectors and, in the latter case, you can select any channel with the TV receiver's channel selector for regular TV viewing.

② **TAPE RUN indicator**
The LED blinks according to the supply reel speed, in synchronism with the tape counter, showing the condition of tape running.

③ **Dolby* NR indicator**
This LED lights when the NR switch ㊼ is set to ON.

④ **TAPE END indicator**
This LED lights when the tape reaches its last portion of about 10 minutes in the Record or Play mode, and then starts flashing about 5 minutes before the end of the tape.

⑤ **Cassette loading slot**
When the sub-power switch ① is set to ON, the cassette loading mechanism becomes operative. Insert a video cassette with its labelled edge facing toward you. The cassette carriage itself will automatically take control and retract the cassette into the correctly loaded position.

⑥ **EJECT button**
Press to eject the cassette.

⑦ **X2 button**
Press for double-speed playback after engaging the Play mode.

⑧ **SLOW button**
Press for slow-motion playback after engaging the Play mode. To vary the slow-motion speed, turn the SLOW SPEED control knob ㊹ .

⑨ **AUDIO DUB button**
Press together with the PLAY button ⑭ to record audio on a pre-recorded tape.

⑩ **REC button**
Press together with the PLAY button ⑭ for video and audio recording.

⑪ **STOP button**
To stop the tape.

⑫ **REW/SHUTTLE SEARCH button**
To rewind the tape. This button can be pressed directly from any mode except the Record and Audio Dub modes. During playback, this button enables high-speed playback at about 9 times normal speed in the reverse direction only while it is being pressed, facilitating fast and accurate location of a particular tape section.

⑬ **PAUSE/STILL button**
To stop the tape temporarily. During recording, press this button to avoid recording unwanted material. During playback, press this button to view a still picture.

⑭ **PLAY button**
To play back the tape. Also press this button together with the REC button ⑩ for recording or with the AUDIO DUB button ⑨ for audio dubbing.

⑮ **Frame advance button (FR ADV)**
To view the playback picture frame by frame. When the button is pressed once after the Still mode has been engaged, the picture is advanced by one frame.

⑯ **FF/SHUTTLE SEARCH button**
To fast forward the tape. This button can be pressed directly from any mode except Record and Audio Dub modes. During playback, this button enables high-speed playback at about 9 times normal in the forward direction only while it is being pressed, facilitating fast and accurate location of a particular tape section.

⑰ **CLOCK SET button**
Press this button when you adjust the clock for the correct time and the day of the week. For details, see page 17.

⑱ **PROG SET button**
Press this button when you want to pre-programme the timer by entering such data as the day of the week, switch-on time, recording length and the channel number of the TV programme from which you want to record.

⑲ **CLOCK button**
Press this button when you want to change the display mode to the Clock mode from the Programme or Clock Set mode.

⑳ **DIMMER button**
The brightness of the display can be subdued by pressing this button.

㉑ **PROG REPEAT button**
After you have entered all programming data for unattended recording, if you wish the entered data to be kept for repeated recording, press this button. The programme repeat indicator ㉕ will be illuminated.

㉒ **PROG NO button**
Press this button in the Programme Set mode to call up a programme number to which the recording data are to be entered. The number of the called-up programme will be displayed on the PROG NO indicator ㉔ .

㉓ **CANCEL button**
Press this button to cancel or "clear" the preset data after calling up the corresponding programme number on the PROG NO indicator ㉔ .

㉔ **PROG NO indicator**
Numerals 1 through 8 are successively displayed to show which programme is ready for entry. Programmes can be called up by pressing the PROG NO button ㉒ in the Programme Set mode either for entry or for checking.

㉕ **Programme repeat indicator**
When a certain scheduled programme is to be recorded repeatedly week after week or every day indefinitely, the PROG REPEAT button ㉑ is to be pressed. Then this indicator lights to indicate that the command for "repeat" has been memorized.

㉖ **Week indicator**
The indication "1st" or "2nd" will be illuminated for setting the day for making timer recordings; "1st" stands for the period within one week and "2nd" within the second week from setting.

㉗ **Day indicator**
Both for constant day indication and day presetting for future recordings.

㉘ **Hour digits**

㉙ **Minute digits**

㉚ **COUNTER/REC LENGTH (MIN) digits**
These smaller 4 figures offer three different functions depending on the selected mode.
In the Clock Set mode (with the CLOCK SET button pressed) a two-digit figure is displayed for counting the seconds.
In the Programme Set mode (with the PROG SET button pressed) or the Sleep Timer mode (see the SLEEP indicator ㉛) three digits are displayed and a recording length (or a period of time after which power will be switched off automatically) can be set in minutes (settings in 5-minute increments up to 395).
Except for these three modes, this section functions as a 4-digit tape counter.

㉛ **SLEEP indicator**
When you wish recording to stop after a certain period of time, set the sub-power switch to TIMER after you have started recording. This is referred to as the Sleep Timer mode and the word "SLEEP" will be illuminated. The period of time after which you want recording to stop can be set on the three-digit display, which shows first "060", by pressing the SELECT and SET buttons. (See page 26.)

㉜ **SELECT button**
Press this button to call up the specific item for setting. When the PROG SET button ⑱ is pressed, the item for setting changes each time this button is pressed in the order of "channel", "day", "hour", "minute" and "recording length", and the corresponding portion of the display flashes.
When the CLOCK SET button ⑰ is pressed, the item for setting changes each time this button is pressed in the order of "second", "minute", "hour" and "day", and the corresponding portion of the display flashes.
In the Sleep Timer mode, when the SELECT button is pressed, the REC LENGTH digits start flashing to show that the setting is ready to be made.

㉝ **SET button**
After selecting the item for setting with the SELECT button ㉜ , press this button until the desired indication is reached. Holding it pressed continuously advances the indication rapidly. However, when you select the "second" setting with the SELECT button ㉜ , the second indication is held at "00" when the SET button is held pressed. This is to set the clock time precisely to the second. (See page 17.)

㉞ **Built-in tuner pre-tuning compartment cover**

㉟ **AFT switch**
Set to ON to activate the built-in Automatic Fine-Tuning circuit for fine picture tuning.

㊱ **CH PRESET switch**
Set to ON when you pre-tune the built-in tuner to TV stations in your area. (See pages 15 and 16.)

㊲ **Preset indicator**
This LED lights when the CH PRESET switch ㊱ is set to ON or SKIP and blinks to show that the pre-tuned station has been memorized by pressing the tuning control (labelled PUSH STORE).

㊳ **Band select switch**
This lever-type switch has three positions; U, III and I as illustrated nearby.
Set it to U for tuning to UHF channels 21 to 69.
Set it to III for tuning to VHF channels 5 to 12.
Set it to I for tuning to VHF channels 2 to 4.

㊴ **Tuning control (PUSH STORE)**
Turn in either direction to tune in to each of up to 12 different television stations in your area. After you have pulled in the station, simply press this same control. Then the indicator ㊲ will start blinking. Blinking will stop in a few seconds. This means that the station was stored in memory.

㊵ **Tuning indicator**
The index line moves as the tuning control is turned so as to provide a rough reference concerning the frequency in each selected band.

㊶ **Sub-power indicator**
When the sub-power switch is set to ON, or when the preset switch-on time is reached with the sub-power switch set to TIMER, this indicator lights.

㊷ **Mains power indicator**
This green LED remains lighted as long as the rear panel MAINS POWER switch is set to ON.

㊸ **MIC jack**
Connect a microphone for audio dubbing or mixed recording.

㊹ **SLOW SPEED control**
During slow-motion playback, turn this knob to obtain your desired speed; toward FAST for faster and SLOW for slower speeds.

㊺ **INSERT indicator**
This LED lights when the Insert Edit mode is engaged. (See (51).)

㊻ **TRACKING controls**
Turn the TRACKING control to minimize noise bars, if observed during playback. Use the 2X/STD control during playback at normal and double-speed, and the SLOW control during slow-motion playback.

㊼ **Dolby* NR switch**
Set to ON to activate the built-in Dolby noise reduction system to eliminate tape hiss noise. Recordings made with the NR switch set to ON should be played back with the NR switch set to ON. The sound quality is not improved if non-Dolbyized recordings are played back with the NR switch set to ON, but the tone differs from the original.

㊽ **SEARCH switch**
Two search modes are available; COUNTER search and CUE search.
When the switch is set to COUNTER, the tape stops automatically at the counter reading of nearly "0000" during fast forward and rewind. When the switch is set to CUE, the tape stops automatically at a point where a new recording was made, during either rewind or fast forward by sensing the cue signal. Refer to page 31. Normally set this switch to OFF.

㊾ **SYSTEM SELECT (STD/MOD) switch**
Set this switch to either STD or MOD when recording SECAM signals, depending on the type of tape desired.
When playing back NTSC tapes, set this switch to either STD or MOD depending on the television system of the monitor being used. For more details refer to "Important information on colour system selection" on pages 4 through 7.

㊿ **SYSTEM SELECT (SECAM/PAL/NTSC) switch**
Use this switch to manually select the appropriate system only when the master SYSTEM SELECT switch (56) is set to MANU. For more details refer to "Important information on colour system selection" on pages 4 through 7.

(51) **INSERT button**
Press this button for insert editing. See page 29.

(52) **V HOLD control**
For adjusting the picture during slow-motion, still-frame and double-speed playback, if the TV receiver's V-hold control fails to correct a phenomenon caused by insufficient vertical lock.

(53) **COUNTER RESET button**
Press this button to reset the counter to "0000".

(54) **Infrared beam receiving window**
For receiving signals from the infrared remote control unit.

(55) **COLOR SYSTEM indicators**
These four indicators show the selected system, according to the detected input signal (in the AUTO mode), or to the switch positions (in the MANU mode). For more details refer to "Important information on colour system selection" on pages 4 through 7.

(56) **SYSTEM SELECT (AUTO/MANU) switch**
This is a master switch for selecting the television system. First set this switch to either AUTO or MANU depending on the required mode. When the MANU mode is selected, set the other two SYSTEM SELECT switches manually as required. For more details refer to "Important information on colour system selection" on pages 4 through 7.

(57) **REC SELECT switch**
For selecting the recording input signal.
Set to TUNER when recording signals coming from the built-in tuner (TV programmes).
Set to AUX when recording signals coming from the units connected to the rear panel VIDEO IN and AUDIO connectors.
Set to CAMERA when recording signals coming from a camera connected to the front panel CAMERA connector (58).

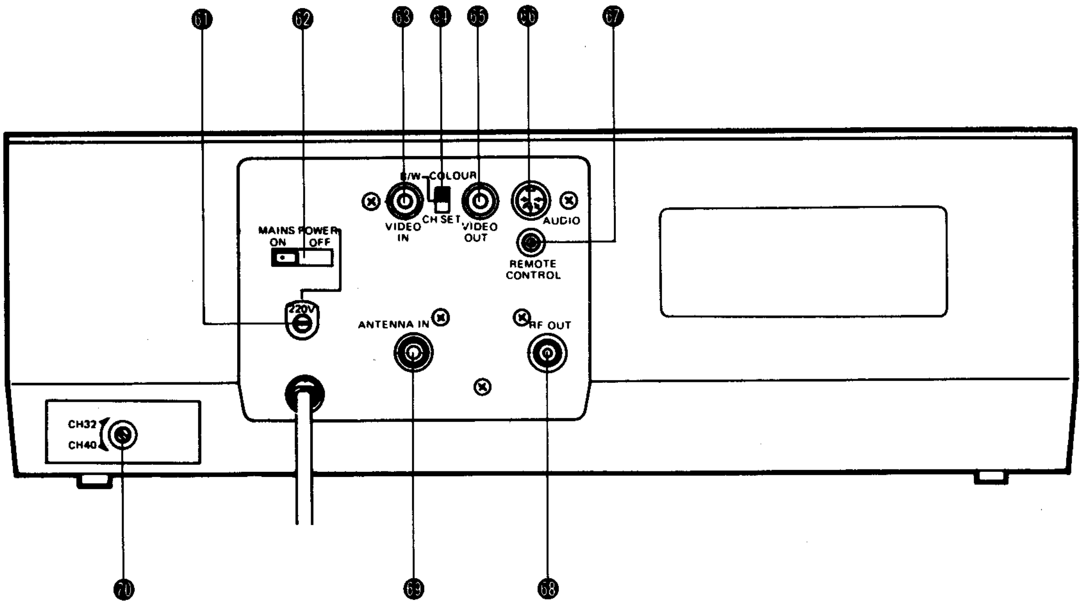
(58) **CAMERA connector**
Connect a JVC video camera directly to this connector using a 10-pin camera cable.
Caution: Other brands of cameras and some JVC cameras may not be electronically compatible, even though the same type of connector is used. Consult your dealer.

(59) **Channel indicators**
The numeral corresponding to the selected channel is illuminated.

(60) **Channel select buttons**
Press to select the specific channel from which you want to record.

*Noise reduction system manufactured under license from Dolby Laboratories Licensing Corporation.
Dolby and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.

Rear Panel



(61) **Voltage selector**
The preset voltage is indicated in the window. If it differs from your local power line voltage, reset it. See "POWER SYSTEM" on page 1.

(62) **MAINS POWER switch**
Switching ON applies mains power to the set. To switch off the set completely, set the MAINS POWER switch to OFF. This switches off the timer/clock circuit and cancels all the preset programming data after the memory backup time (about 10 minutes) has elapsed. This also switches off the built-in aerial circuit so that the TV receiver connected to the HR-7600MS will not be able to receive off-the-air TV programmes for good viewing condition. Normally set this MAINS POWER switch to ON.

(63) **VIDEO IN connector**
Connect the video output of other video equipment such as another video tape recorder.

(64) **Video mode select switch**
This applies to both recording and playback.
COLOUR: Set to this position when the input or playback video signal is in colour.
B/W: Set to this position when the input or playback video signal is monochrome.
CH SET: Set to this position when tuning your TV receiver for the "Video Channel".

(65) **VIDEO OUT connector**
Video signals being recorded or played back are available from this connector.

(66) **AUDIO input/output DIN socket**
Connect a tape recorder or other audio sources or connect the audio output of other video sources for recording. Also, audio signals being recorded or played back are available from the output terminals of this DIN socket.

(67) **REMOTE CONTROL connector**
The RM-P73U wired remote control unit, optionally available, can be connected to this terminal.

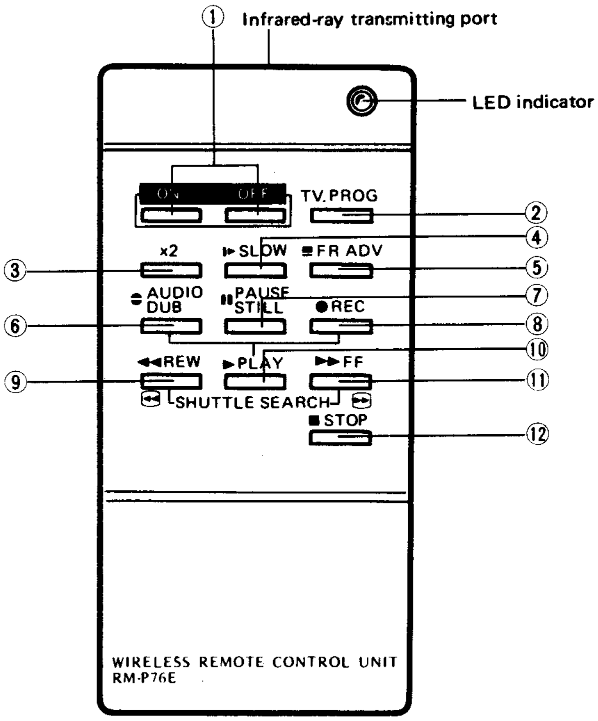
(68) **RF OUT connector**
Connect to the antenna connector of a TV receiver through the aerial cable (provided).

(69) **ANTENNA IN connector**
Connect an aerial to this connector.

(70) **RF converter frequency adjustment screw**
To re-adjust the output frequency of the built-in RF converter. (See page 14.)

Infrared remote control unit

The infrared remote control unit provided, lets you control 16 functions from your viewing position.


① Infrared-ray transmitting port
LED indicator
ON
OFF
TV.PROG
②
④
x2
SLOW
FR ADV
③
⑤
AUDIO DUB
PAUSE STILL
REC
⑥
⑦
⑧
⑩
REW
PLAY
FF
⑨
⑪
SHUTTLE SEARCH
STOP
⑫
WIRELESS REMOTE CONTROL UNIT
RM-P76E

① **ON/OFF buttons**
To switch power on or off for the recorder.
Notes
- These buttons are not to switch the power circuit of the remote control unit itself on or off. The remote control unit is always ready to operate. It consumes power only at the time the buttons are being pressed.
- In order for the remote control unit to be able to switch the power for the recorder on or off, the recorder's sub-power switch should be in the ON position.

② **TV. PROG button**
Press this button a number of times until the desired channel number is illuminated on the recorder's channel indicator.

③ **X2 button**
To play back the tape at a speed twice the normal. Before pressing this button, press the PLAY button.

④ **SLOW button**
To view slow-motion playback. Before pressing this button, press the PLAY button.

⑤ **FR ADV button**
To advance the playback picture frame by frame in the Still mode.

⑥ **AUDIO DUB button**
Press together with the PLAY button ⑩ for audio dubbing.

⑦ **PAUSE/STILL button**
To stop the tape temporarily during recording or playback.

⑧ **REC button**
Press together with the PLAY button ⑩ for starting recording.

⑨ **REW/SHUTTLE SEARCH button**
To rewind the tape or to play back the tape at 9 times normal speed in the reverse direction.

⑩ **PLAY button**
To play back the tape.

⑪ **FF/SHUTTLE SEARCH button**
To rewind the tape or to play back the tape at 9 times normal speed in the forward direction.

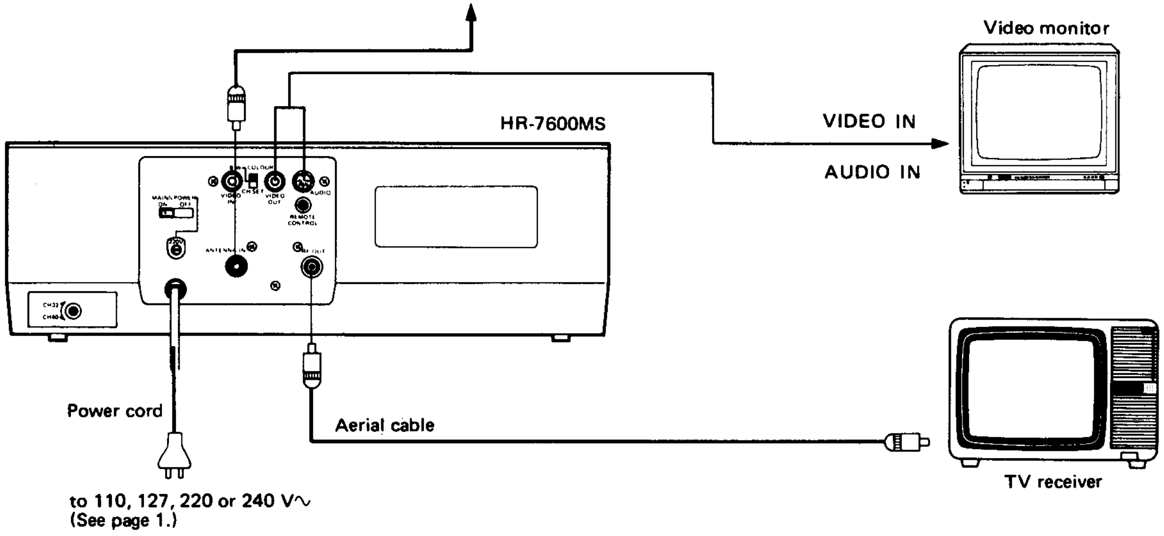
⑫ **STOP button**
To stop the tape.

PART II

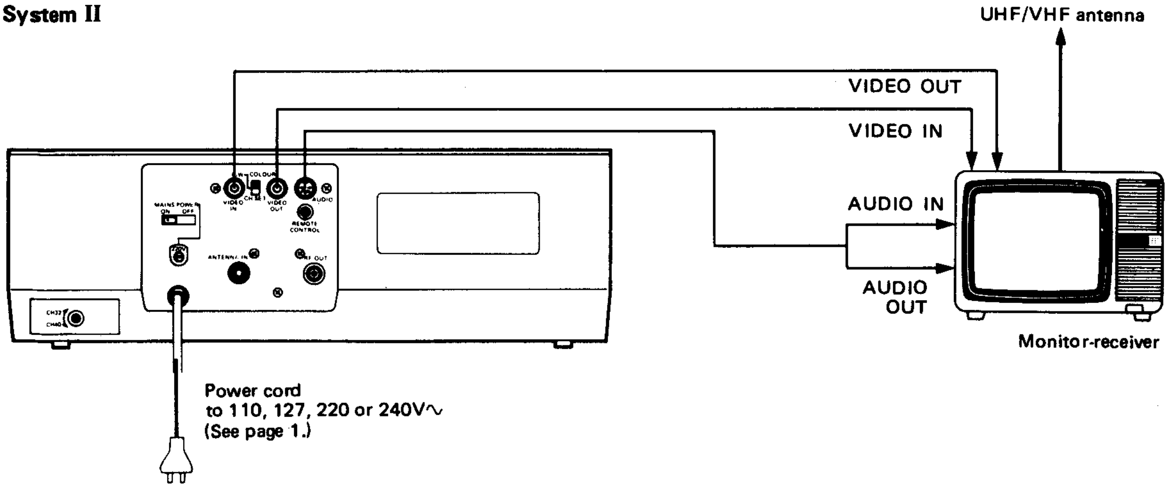
PREPARATIONS

HOW TO CONNECT THE HR-7600MS TO YOUR TV SET

System I


UHF/VHF antenna
Video monitor
HR-7600MS
VIDEO IN
AUDIO IN
Power cord
Aerial cable
TV receiver
to 110, 127, 220 or 240 V∿
(See page 1.)

System II


UHF/VHF antenna
VIDEO OUT
VIDEO IN
AUDIO IN
AUDIO OUT
Monitor-receiver
Power cord
to 110, 127, 220 or 240V∿
(See page 1.)

System I

When the built-in PAL tuner is appropriate for your area

1. Remove the antenna cable from your TV receiver and reconnect it to the HR-7600MS as illustrated. The HR-7600MS is then ready to record off-air TV programmes.
2. Connect the HR-7600MS to the TV receiver using the aerial-cable provided. The TV receiver is then ready to receive TV broadcast programmes as well as video cassette programmes from the HR-7600MS.
3. When you use a video monitor for playback, connect the VIDEO OUT and AUDIO connectors of the HR-7600MS to the VIDEO IN and AUDIO IN connector of the video monitor.

Note

Even when you are not using the HR-7600MS, the rear panel MAINS POWER switch should be set to ON in order to be able to view TV broadcast programmes with this connection.

System II

When a separate tuner (or monitor-receiver) is required

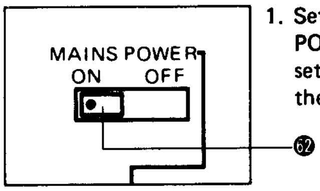
1. Connect the HR-7600MS to a monitor-receiver as illustrated. This connection enables you to receive TV broadcasts with the tuner in the monitor-receiver, and record them with the HR-7600MS.

HOW TO SET YOUR VIDEO CHANNEL

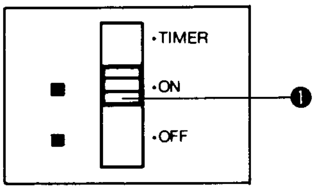
The RF converter built into the HR-7600MS conforms to the PAL B/G system. When you view video programmes on a TV receiver through this RF converter, follow the instructions below.

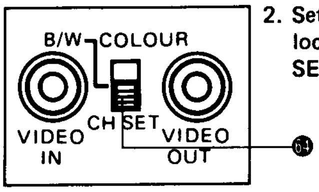
Viewing video cassettes means that the TV receiver receives video playback signals just like it receives broadcast signals. For this purpose, the TV receiver must be set to a specific channel. That channel is "YOUR VIDEO CHANNEL". And it is the built-in RF converter that determines your video channel, since the RF converter permits playback of video and audio recordings through a TV receiver. The signals from the RF converter are viewed through a vacant channel not used for broadcasting. The converter channel of all units is set to UHF channel 36 prior to shipment. Setting your TV receiver to UHF channel 36 may provide video playback. However, to obtain the best possible reproduction on your TV receiver, accurate adjustment to the RF converter output is required.

Procedure

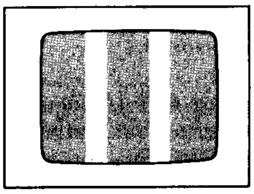


1. Set the rear panel MAINS POWER switch (62) to ON and set the sub-power switch ① on the front panel to ON.



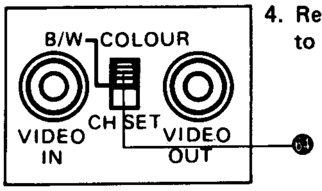


2. Set the video mode switch (64), located on the rear panel, to CH SET (Channel Setting).



3. Adjust your TV receiver in the vicinity of UHF channel 36 until you bring in the two white signal bars on the screen as illustrated.

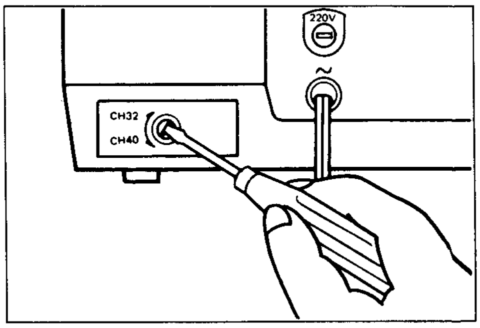
This setting is now the VIDEO CHANNEL of the TV receiver to which the HR-7600MS is connected.



4. Reset the video mode switch (64) to COLOUR.

Notes

- When you adjust your TV receiver to channel 36 for video playback, if some interference noise is seen on the screen because of broadcasts on neighbouring channels or if your preset UHF broadcasts should be affected in picture quality, it is necessary to shift slightly the RF converter output frequency from that of channel 36.

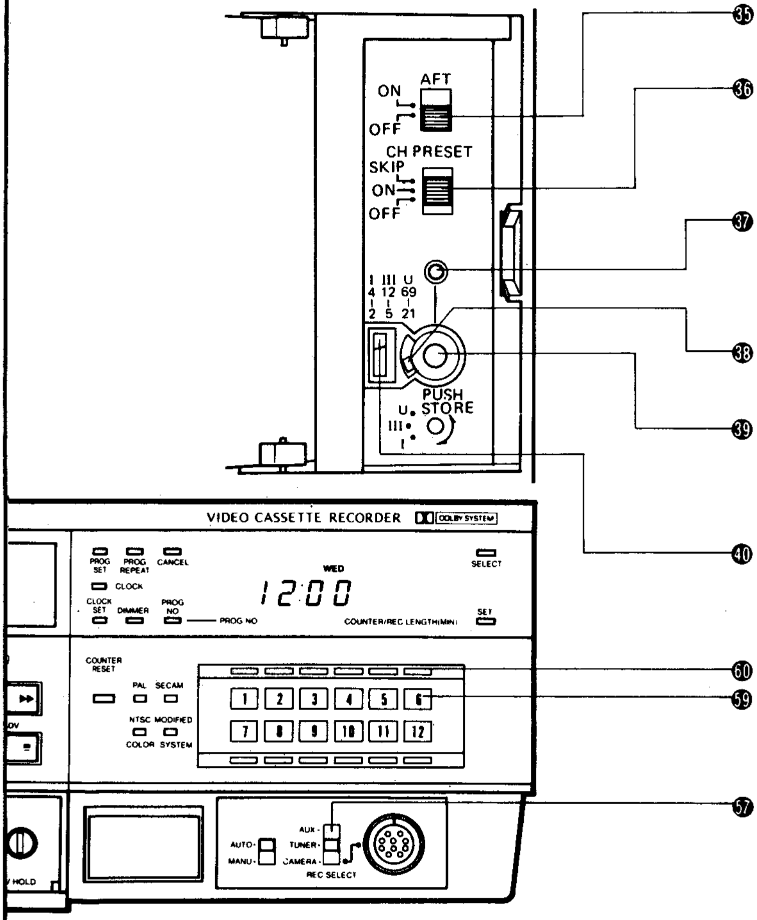


For this purpose, insert a small screwdriver into the RF converter frequency adjustment screw (70) and adjust it in minute steps. Then tune the TV receiver once again until a clear picture is obtained.
This adjustment requires extreme precision and must be done with the utmost care. We recommend that you consult your JVC dealer for making this adjustment.

- Be sure to set the video mode switch to COLOUR after VIDEO CHANNEL tuning has been completed.
- No signal is available from the VIDEO OUT terminal while the Channel Setting signal is being used.
- If a prerecorded VHS cassette is available, TV adjustment for VIDEO CHANNEL setting is also possible using it to obtain a playback picture. Insert the cassette and operate the HR-7600MS for playing back the cassette (See Part III "How to load and unload the video cassette" and "How to play back the video cassette".) Then tune the TV receiver to obtain clear pictures and sound while monitoring the playback picture on the TV screen.
- If your TV receiver is not provided with an AFC circuit, perform fine tuning of the TV receiver when you are actually viewing video cassettes.

HOW TO PRE-TUNE THE BUILT-IN TUNER

Basic guidelines


AFT
ON
OFF
CH PRESET
SKIP
ON
OFF
I III U
4 12 69
2 5 21
PUSH
U. STORE
III•
I•
VIDEO CASSETTE RECORDER
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00
PROG NO
COUNTER/REC LENGTH(MIN)
SELECT
SET
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
AUX
AUTO
TUNER
MANU
CAMERA
REC SELECT
HOLD

㉟ **AFT switch**
For automatic fine picture tuning.

㊱ **CH PRESET switch**
Engages or disengages the Channel Preset mode. Also used to preset the channels to be skipped.

㊲ **Indicator**
Lights in the Channel Preset mode and blinks when the tuned-in station is memorized.

㊳ **Band select switch**
To select the TV station frequency band.

㊴ **Tuning control**
Used to tune in to a desired TV station. Pressing this control permits the pre-tuned TV station to be held in memory.

㊵ **Tuning indicator**
Moves to indicate where you are in the selected frequency band.

(60) **Channel select buttons**

(59) **Channel indicators**

(57) **REC SELECT switch**

The built-in tuner of the HR-7600MS has a capacity of receiving 12 different channels. You can preset any TV station in your area to any one of these 12 channels. It is you who determine what TV station to specify for what channel number.

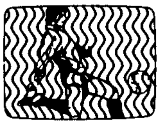
The basic procedure is: select a channel number, tune in to a station and store the information. Then you can easily call up any preset station simply by pressing the corresponding channel select button.

The built-in tuner conforms to the PAL B/G system. When you use the built-in tuner to record TV broadcasts, perform pre-tuning following the instructions in this chapter.

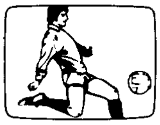
Procedure

1. Set the sub-power switch ❶ to ON.
2. Switch the power of the TV receiver ON.
3. Set the REC SELECT switch (57) to TUNER.
4. Adjust the TV receiver's channel to your VIDEO CHANNEL. (See page 14.)
   - Now a TV programme, if being received by the built-in tuner, will be shown on the screen of the TV receiver. And now you are ready to preset the built-in tuner to TV stations in your area while monitoring the picture on the TV screen.
5. Open the pre-tuning control compartment cover.
6. Set the CH PRESET switch ㊱ to ON.
   The indicator ㊲ will light. And the AFT (Automatic Fine Tuning) circuit will be switched off automatically regardless of the setting of the AFT switch ㉟ .
7. Press the channel select button which you have chosen to allocate to the station to be pre-tuned in. The channel number corresponding to the selected channel will be illuminated.

8. Set the band select switch ㊳ as required.
   Set to I when tuning in to VHF channels 2 through 4.
   Set to III when tuning in to VHF channels 5 through 12.
   Set to U when tuning in to UHF channels 21 through 69.
9. Turn the tuning control ㊴ while observing the TV screen to tune in to a desired station.
   - Turning the tuning control in either direction moves the tuning indicator in the corresponding direction.
10. To obtain the best possible picture, make further adjustments.



Striped picture



Clean picture

   - Turn the tuning control first until you get the striped picture and then slowly turn, little by little, to clear up the picture.
11. Push in the same tuning control ㊴ to store the information.
   - The indicator will start blinking. Blinking will stop in a few seconds. This means that the station was stored in memory.
   - If you should happen to turn the tuning control while the indicator is still blinking, the channel lock mechanism will engage and, therefore, if you press another channel select button it will have no effect. To correct this situation in order to proceed with presetting other channels, press the tuning control once again and wait for the blinking of the indicator to stop so that the preset information for the channel you selected last will be stored.
12. Perform the same adjustments, steps 7 through 11, for each of the other channels.
13. If everything is alright, return the CH PRESET switch ㊱ to OFF.
14. Make sure that the AFT switch ㉟ is set to ON.
15. Close the compartment cover.

Notes

- Normally set the AFT switch ㉟ to ON.
  If neighbouring channels are close to each other, set this switch to OFF.
- If the picture is still not clear, perform fine tuning on your TV receiver.
- Distorted pictures or sound will be recorded if fine tuning has not been properly performed. Exercise care with this adjustment since the recorded picture and sound cannot be adjusted later.

Skipping unused channels

Though 12 channels are available for presetting to desired TV stations, you may not need all 12 channels. In such cases, unused channels can be skipped so that only preset channels are operable. This function is especially convenient when you select the channel via the remote control unit which has only one button for channel selection. If some channels are skipped, you don't have to press the CHANNEL button of the remote control unit a number of times to reach your desired channel.

To skip the channels, proceed as follows:

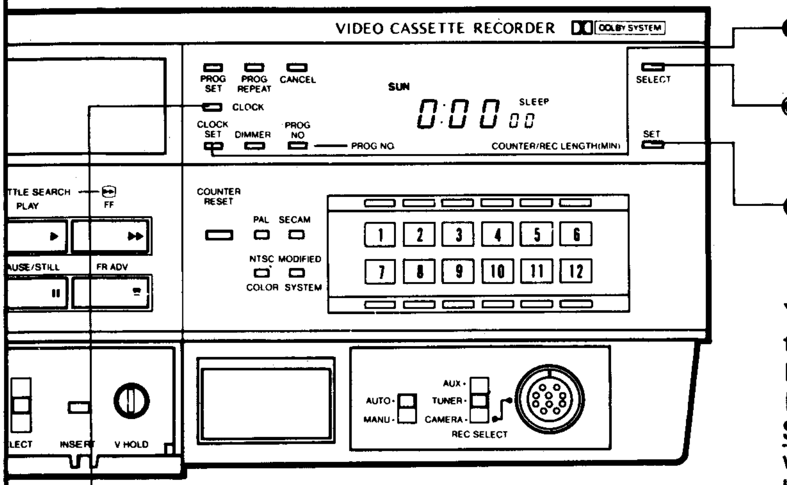
1. Select the channel you want to skip by pressing the corresponding channel select button (60) .
2. Set the CH PRESET switch ㊱ to SKIP.
   - The indicator will light.
3. Push in the tuning control ㊴ .
   The indicator will blink momentarily and remain lit after that. This means that the information for skipping that channel has been stored in memory.
4. Select another channel that you wish to skip and repeat the same procedure as above.
5. Return the CH PRESET switch ㊱ to OFF.

Note

- It is possible to restore the skipped channels for presetting to another TV station whenever necessary. For this purpose, set the CH PRESET switch to ON and press the channel select button corresponding to the channel you want to restore. Then tune in to your desired station and store it in the same manner as described above.
- Channel 1 cannot be skipped.
- When a channel which has been already preset to a station is skipped, the stored information for that channel will be cancelled. Therefore, if you wish to restore the skipped channel, you should perform the channel presetting procedure for that channel once again.

HOW TO SET THE CLOCK

Basic guidelines



⑰ **CLOCK SET button**
Engages the Clock Set mode.

㉜ **SELECT button**
Selects the item for setting; "second", "minute", "hour" and "day".

㉝ **SET button**
Enters the required data for each selected item.

⑲ **CLOCK button**
Engages the Clock mode.

You need only four controls to set the clock.
First, CLOCK SET and last, CLOCK.
In between, only SELECT and SET.
Select the item (the called-up item will flash to indicate that it is ready to be set) and set it by entering the correct data.

Procedure

When the HR-7600MS is plugged into an AC outlet and the rear panel MAINS POWER switch is turned ON, the display shows a flashing "SUN 0:00". Now you are ready to set the built-in clock to the correct local time.

1. Press the CLOCK SET button ⑰ , and the "second" digits will start counting while flashing.
2. Press the SELECT button ㉜ , and then the "minute" digits will start flashing.
3. Press the SET button ㉝ until the correct minute indication is displayed.
4. Press the SELECT button ㉜ , and then the "hour" digits will start flashing.
5. Press the SET button ㉝ until the correct hour indication is displayed.
6. Press the SELECT button ㉜ , and then the "SUN" indication will start flashing.
7. Press the SET button ㉝ until the correct day is displayed.
8. Press the SELECT button ㉜ , and then the "second" digits will start flashing.
9. Hold the SET button ㉝ pressed, and the seconds will be reset to and held at "00".
   - If the "second" indication is over "30" (from 30 to 59), pressing the SET button will reset the "second" digits to "00" but will give one increment to the minute indication (for example, 10'35" – 11'00").
10. Release the button at the exact instant of the reference time signal (radio, telephone, TV, etc.) and the clock will be set accurately to the correct local time.
11. Press the CLOCK button ⑲ to return to the Clock mode. No item will be flashing any more. And the "second" digits will turn off.

Notes

- Holding the SET button pressed for more than 1 second continuously advances the minute, hour or day indication automatically. Pressing it once advances the indication in single increments only.
- During the Clock Set mode, if no command is entered within two minutes, the Clock mode will be automatically engaged. If you have not yet made the clock setting, press the CLOCK SET button once again to engage the Clock Set mode.
- Clock setting is impossible with the sub-power switch ❶ set to the TIMER position.

Power failure indicator

- If you find "SUN 0:00" flashing on the display, it means that a power failure has occurred and time-keeping has not taken place since that time.
- Correct the time indication following the above procedures.
- If the period of power outage is within about 10 minutes, correct time-keeping continues when power is reapplied.
- During this 10-minute period, the built-in memory back-up capacitor maintains time-keeping and preset timer memory, though the display blacks out.
- The memory back-up capacitor is automatically being recharged as long as the rear panel MAINS POWER switch is set to ON. It takes about 30 minutes to recharge this capacitor from its fully discharged condition.

Readjusting the clock time

- If a slight increase or reduction of time indication is found, readjust the clock following the same procedure as for time setting.
- Remember that the seconds from 0 to 29 will be reset to "00" when the SET button is pressed and the seconds from 30 to 59 will be reset to "(+1'):00".

PART III BASIC OPERATION

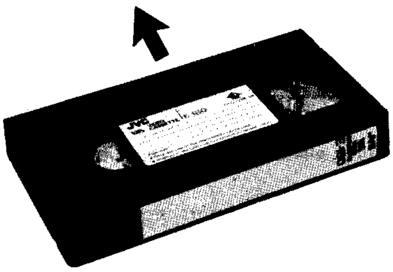
HOW TO LOAD AND UNLOAD THE VIDEO CASSETTE

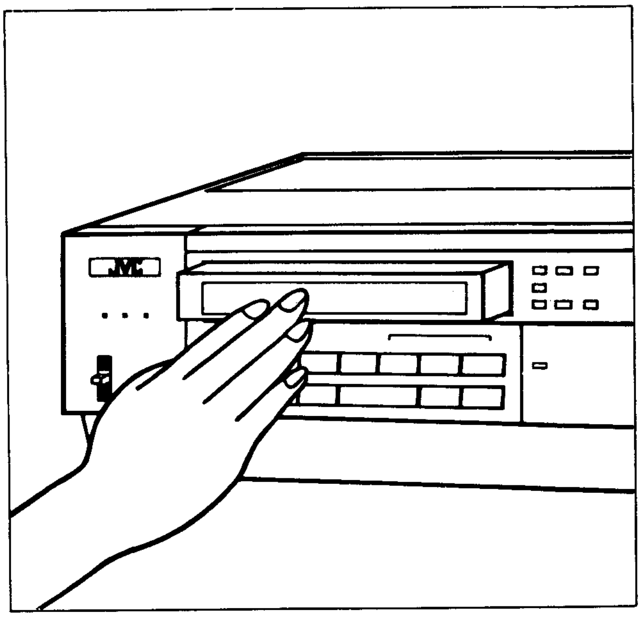
Caution

- Since the HR-7600MS employs a motorized cassette loading system, loading and unloading the cassette are only possible when the power is applied to the recorder section. Do not force the cassette into the cassette loading slot while the front panel sub-power switch is set to OFF.
- Do not attempt to pull out the cassette once automatic loading has started.

Loading

1. Set the sub-power switch ❶ to ON.
2. Insert a cassette with its labelled side facing you. The cassette will automatically be retracted and loaded in the correct position.
   - The STOP indicator will be flashing during automatic loading of the cassette and, when it has been correctly loaded, will remain lighted.
   - The automatic loading mechanism will operate only when the cassette is inserted correctly.
   - If loading into the correct position is not executed, the cassette will automatically be ejected after about 6 seconds.





Unloading

1. Press the EJECT button ❻. The cassette will automatically be ejected. Then, simply remove it from the cassette loading slot.
   - The EJECT indicator will be flashing during automatic unloading of the cassette and then turn off upon completion of ejection.
   - The EJECT button can be pressed during any mode except Record and Audio Dub.

HOW TO RECORD A TV PROGRAMME WHILE WATCHING IT

Basic guidelines

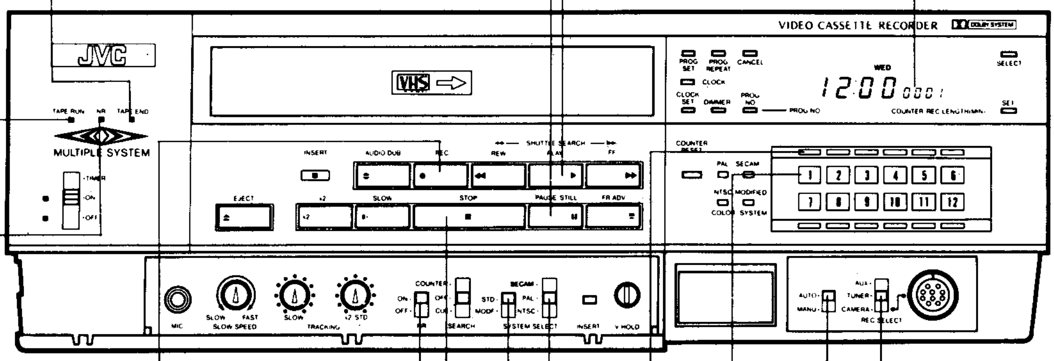
② **TAPE RUN indicator**
Flashes to show that the tape is running.

④ **TAPE END indicator**
Lights 10 minutes before the end of the tape and starts flashing 5 minutes before the end of the tape.

⑬ **PAUSE/STILL button**
To stop the tape temporarily.

⑭ **PLAY button**
To start tape transport.

㉚ **Tape counter**
When the sub-power switch is set to ON, this 4-digit tape counter is illuminated.


JVC
VIDEO CASSETTE RECORDER
VHS
MULTIPLE SYSTEM
TAPE RUN
NR
TAPE END
EJECT
INSERT
AUDIO DUB
REC
REW
PLAY
FF
SLOW
STOP
PAUSE STILL
FR ADV
SHUTTLE SEARCH
COUNTER
PAL
SECAM
NTSC
COLOR SYSTEM
MIC
SLOW SPEED
TRACKING
SYSTEM SELECT
REC SELECT
AUTO
MANU
AUX
TUNER
CAMERA
12:00

③ **Dolby NR indicator**

⑩ **REC button**
To start recording.

⑪ **STOP button**
To stop recording.

㊾ ㊿

(56) (57) **REC SELECT switch**
Setting to TUNER activates the built-in tuner.

㊼ **NR switch**
To improve sound quality.

(59) **Channel indicators**
The selected channel will be illuminated.

(60) **Channel select buttons**
For selecting the specific channel from which you want to record.

Now you are ready to record your favourite TV programmes. Guidelines for doing this: receive the desired TV programme with the built-in tuner and operate the tape section.

Confirm the settings of the SYSTEM SELECT switches ㊾ , ㊿ and (56) by referring to the chart on page 7.

This section describes the recording procedure when the built-in tuner (which conforms to the PAL B/G system) is used. If a separate tuner (or monitor-receiver) is used to record broadcast programmes, see the next page.

Preparation

1. Set the sub-power switch ① to ON.
2. Load a cassette.
3. Set the REC SELECT switch (57) to TUNER.
4. Set the channel selector of your TV receiver to your VIDEO CHANNEL. (See page 14.)
5. Press the channel select button corresponding to the channel you wish to record.
   - The picture you are going to record will appear on the TV screen, but recording is not yet taking place.
   - If a clear picture or correct colour is not obtained, tuning may not have been done accurately. Re-perform tuning in the manner described in "HOW TO PRE-TUNE THE BUILT-IN TUNER" on pages 15 and 16.

Recording

1. Press the REC and PLAY buttons ⑩ ⑭ simultaneously. Recording will start.
   - When these buttons are pressed, first the tape is pulled out from the cassette and loaded around the tape transport mechanism. During this period, the PLAY indicator will flash.
   - Then recording starts while the tape is running. In this state, both the REC and PLAY indicators remain lighted.
2. Set the NR switch ㊼ to ON if you wish to make hiss-less recordings.
   - The Dolby NR indicator ③ will light.
3. To skip recording part of the programme, press the PAUSE/STILL button ⑬ . The tape will stop while remaining in the Record mode.
   - The PAUSE/STILL indicator will light with also the REC and PLAY indicators remaining lighted.
4. To release the Pause mode, press the PLAY button ⑭ .
5. To stop recording, press the STOP button ⑪ .
   - When the STOP button is pressed, first the tape is unloaded from around the tape transport mechanism. During this period, the STOP indicator will flash. When the tape has returned into the cassette, the indicator remains lighted.
   - When the end of the tape is reached during recording, the tape is automatically rewound to the beginning and stops. During rewinding, the REW indicator lights and, when the tape reaches the beginning, the STOP indicator lights.

Notes

- For using the tape counter, see page 31.
- If the REC button cannot be pressed, check to see if the cassette safety tab has been removed. (See page 3.)
- Sound from a microphone connected to the MIC jack can be mixed with the TV sound being recorded.
- The Pause mode is released automatically after about 6 minutes in order to prevent tape damage and the Stop mode is engaged.
- The built-in automatic channel lock mechanism prevents the selected channel from being altered during recording. Therefore, if you wish to change the channel during recording, first engage the Pause mode and then select a different channel.
- For your reference, this automatic channel lock mechanism operates in the following cases:
  (1) when the sub-power switch is in the OFF position,
  (2) in the Programme Set mode,
  (3) when the REC SELECT switch is in the AUX or CAMERA position,
  (4) when a tape is being played back, and
  (5) in the Record mode.
  Because of this, when you set the sub-power switch to ON after it has been set to OFF, the same channel which was selected last will be received. The same applies to case (3). When you return the REC SELECT switch to TUNER from AUX or CAMERA, the last channel is memorized.

HOW TO RECORD ONE TV PROGRAMME WHILE WATCHING ANOTHER

A programme, not being viewed, can be recorded while you enjoy viewing another programme. This permits the recorded programme to be played back later at your convenience. The recording procedures are exactly the same as when recording a TV programme while watching it.

The key points to be remembered are:

- Select the channel you wish to record with the recorder's channel select buttons (60) .
- Select the channel you wish to view with the TV receiver's channel selector.

HOW TO RECORD A TV PROGRAMME FROM A MONITOR-RECEIVER

- Set the REC SELECT switch (57) to AUX.
- Select the channel you wish to record with the monitor-receiver's channel selector.

Other steps are identical to those for recording with the built-in tuner. However, when using a separate monitor-receiver, it is not possible to record one programme while watching another.

HOW TO PLAY BACK THE VIDEO CASSETTE

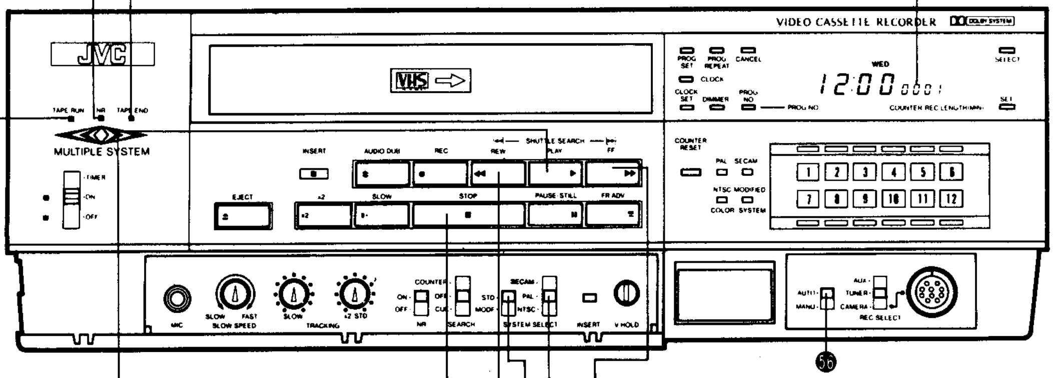
Basic guidelines

② **TAPE RUN indicator**
Flashes to show that the tape is running. Its flashing interval is accelerated or decelerated according to the tape supply reel speed.

④ **TAPE END indicator**
Lights 10 minutes before the end of the tape and starts flashing 5 minutes before the end of the tape.

㉚ **Tape counter**
See page 31.

③ **Dolby NR indicator**


JVC
TAPE RUN
NR
TAPE END
MULTIPLE SYSTEM
TIMER
ON
OFF
VHS
VIDEO CASSETTE RECORDER
INSERT
AUDIO DUB
REC
REW
PLAY
FF
SHUTTLE SEARCH
EJECT
×2
SLOW
STOP
PAUSE STILL
FR ADV
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00
COUNTER REC LENGTH
SELECT
SET
COUNTER RESET
PAL
SECAM
NTSC MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
MIC
SLOW
FAST
SLOW SPEED
SLOW
±2 STD
TRACKING
ON
OFF
NR
COUNTER
OFF
CUE
SEARCH
STD
MODF
SECAM
PAL
NTSC
SYSTEM SELECT
INSERT
V HOLD
AUTO
MANU
AUX
TUNER
CAMERA
REC SELECT
㊻
㊾
㊿

⑭ **PLAY button**
To start playback.

⑪ **STOP button**
To stop playback.

⑫ **REW/SHUTTLE SEARCH button**
To rewind the tape or to play back the tape at about 9 times normal speed in the reverse direction to locate the desired tape section.

⑯ **FF/SHUTTLE SEARCH button**
To fast forward the tape or to play back the tape at about 9 times normal speed in the forward direction to locate the desired tape section.

Confirm the settings of the SYSTEM SELECT switches ㊾, ㊿ and (56) by referring to the chart on page 7.

Procedure

1. Set the sub-power switch ① to ON.
2. Load a cassette.
3. Set the channel selector of your TV receiver to your VIDEO CHANNEL. (See page 14.)
   When using a monitor-receiver, select the A/V channel specified on the model being used.
4. Press the PLAY button ⑭ .
5. Make sure that the Dolby NR indicator ③ lights if you play back tapes recorded with the NR switch ON. If it does not light, open the sub-panel cover and set the NR switch ⑰ to ON.
6. To stop playback, press the STOP button ⑪ .
   - When the end of the tape is reached during playback, the tape is automatically rewound to the beginning.

Rewinding and fast forwarding the tape

- The same button is used for rewind and reverse shuttle search. To rewind the tape, press the REW/SHUTTLE SEARCH button ⑫ in the Stop mode. When the beginning of the tape is reached, the Stop mode is automatically engaged. If you wish to stop rewinding midway, press the STOP button ⑪ .
- The same button is used for fast forward and forward shuttle search. To fast forward the tape, press the FF/SHUTTLE SEARCH button ⑯ in the Stop mode. When the end of the tape is reached, the tape automatically starts rewinding. If you wish to stop it midway, press the STOP button ⑪ .

Shuttle search function

The unique "shuttle search" function permits you to reach quickly your desired tape section while following the playback picture on the TV screen. The tape speed is about 9 times the normal and "search for a scene" is possible in both directions; either forward or reverse. This is why this function is named "shuttle search".

- After engaging the Play mode, press the FF/SHUTTLE SEARCH button ⑯ or REW/SHUTTLE SEARCH button ⑫ depending on the direction in which you are going to search for a particular scene and hold it until your desired scene appears on the screen. Releasing the button restores the normal Play mode.
- Since the audio circuit is switched off in this mode, you are free from "unintelligible" sound.

Notes

- For usage of the tape counter and SEARCH switch, refer to page 31.
- If the playback picture contains noise bars, adjustment with the TRACKING controls may be necessary. Refer to page 31.
- NTSC tapes recorded in the LP (Long Play) or EP (Extended Play) mode cannot be played back on this unit. If playback is attempted with such a tape in the AUTO mode, the NTSC indicator will flash.

HOW TO ENJOY VARIABLE-SPEED PLAYBACK

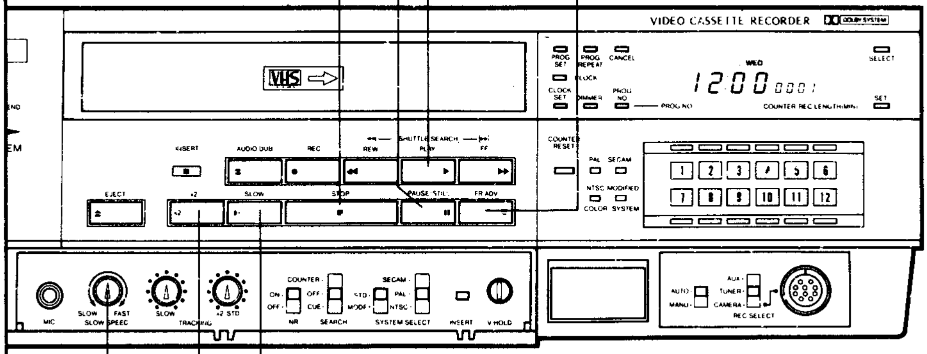
Basic guidelines

⑭ PLAY button
To engage the Play mode.

⑬ PAUSE/STILL button
To view a still picture.

⑮ FR ADV button
To view still pictures successively by advancing the tape by one frame at a time.

⑪ STOP button
To stop playback.


VIDEO CASSETTE RECORDER
VHS
INSERT
AUDIO DUB
REC
REW
PLAY
FF
SHUTTLE SEARCH
EJECT
×2
SLOW
STOP
PAUSE/STILL
FR ADV
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
TIMER
PROG NO
WED
12:00 0001
COUNTER REC LENGTH
SELECT
SET
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
MIC
SLOW
FAST
SLOW SPEED
TRACKING
×2 STD
COUNTER
ON
OFF
CUE
NR
SEARCH
SECAM
STD
MODE
PAL
NTSC
SYSTEM SELECT
INSERT
V HOLD
AUX
AUTO
MANU
TUNER
CAMERA
REC SELECT

⑧ SLOW button
To view slow-motion pictures at variable speeds.

⑦ X2 button
To watch a programme in half the usual time.

(44) SLOW SPEED control
To vary the slow-motion playback speed according to your needs.

To view still-frame, slow-motion or fast-motion playback, first you have to engage the Play mode by pressing the PLAY button. Then any time you can switch to variable-speed playback by pressing the corresponding button.

Double-speed playback

- After engaging the Play mode by pressing the PLAY button ⑭, press the X2 button ⑦. The X2 indicator will light and playback will take place at a speed twice the normal.
- To restore the normal playback speed, press the PLAY button ⑭.
- This function will be especially convenient for quickly running through longer tape sections while at the same time following the contents until you reach the actual section you want to view at the normal speed.
- No audio is heard in the Double-speed mode.

Slow-motion playback

- After engaging the Play mode by pressing the PLAY button ⑭, press the SLOW button ⑧. The SLOW indicator will light and playback will take place at a slower speed.
- You can increase or decrease the slow-motion speed according to your needs. For this purpose, after engaging the Slow mode by pressing the SLOW button ⑧, open the sub-control panel cover and turn the SLOW SPEED control (44) in either direction until you get the desired speed.
- The slow-motion speed is variable from approx. 1/5 to 1/25 the normal.
- No audio is heard in the Slow-motion mode.
- The Slow-motion mode is released automatically after about 6 minutes in order to prevent tape damage and the Stop mode is engaged.

Still-frame playback

- After engaging the Play mode by pressing the PLAY button ⑭, press the PAUSE/STILL button ⑬. The PAUSE/STILL indicator will light and the picture will "freeze" instantly.
- To release the Still mode, press the PLAY button ⑭.
- The Still mode is released automatically after about 6 minutes in order to prevent tape damage and the Stop mode is engaged.

Frame advancing

- While in the Still mode, you can advance the picture frame by frame.
- Pressing the FR ADV button ⑮ once, advances the picture by one frame.
- This function will be convenient to search for the precise instant of a crucial scene you wish to view.
- No indicator lights in the FR ADV mode.

Notes

- During still-frame or slow-motion playback, the TV picture might vibrate horizontally. To reduce such vibrations, we recommend that you employ the AV channel for video playback if your TV receiver is provided with such. If the vibrations are rather excessive, consult your local JVC dealer.
- For tracking adjustment during double-speed or slow-motion playback, refer to page 31.

PART IV

ADVANCED USAGE

HOW TO PRESET THE TIMER FOR UNATTENDED RECORDING

Basic guidelines

㉔ **PROGRAM NO indicator**
Displays the called-up programme number.

㉕ **Programme repeat indicator**

㉖ **Week indicator**

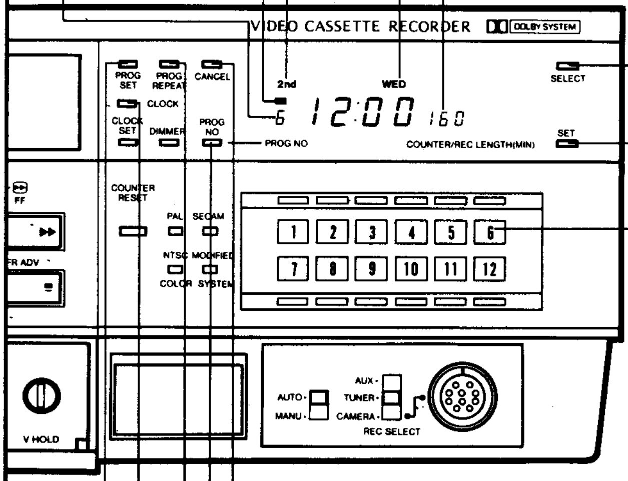
㉗ **Day indicator**

㉚ **COUNTER/REC LENGTH (MIN) digits**
Displays the recording length in minutes in the Programme Set mode.

㉜ **SELECT button**
Selects the item for setting; "channel", "week", "day", "hour", "minute" and "recording length".

㉝ **SET button**
Sets the required data for each called-up item.

(59) **Channel indicators**
The selected channel to be recorded later will flash.



VIDEO CASSETTE RECORDER
DOLBY SYSTEM
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
2nd
WED
6
12:00
160
SELECT
SET
PROG NO
COUNTER/REC LENGTH(MIN)
FF
FR ADV
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
V HOLD
AUTO
MANU
AUX
TUNER
CAMERA
REC SELECT

㉓ **CANCEL button**
To cancel the preset data.

㉒ **PROG NO button**
To call up a programme memory on which recording data are to be entered.

㉑ **PROG REPEAT button**
For repeated pre-programmed recording.

⑲ **CLOCK button**

⑱ **PROG SET button**
Engages the Programme Set mode.

Timer recording is possible only when the built-in tuner (conforms to the PAL B/G system) is used.

The built-in 2-week/8-programme programmable timer permits recording of preset channels on preset days, at preset times for preset lengths while you are away. First preset the programmable timer and then operate the recorder section for unattended recording (this procedure is described in the next chapter). Guidelines for presetting the timer: Call up a programme number among 1 through 8 and enter the programming data with the SELECT and SET buttons.

Procedure

1. Press the PROG SET button ⑱
   - The display will be changed from the Clock mode to the Programme Set mode.

1st
SUN
000
000

- When the PROG SET button is pressed, programme No. 1 is always called up first. If you wish to change the programme number, press the PROG NO button ㉒ .

2. Press the SET button ㉝ until the TV programme channel number you want to record is illuminated.
    - In the Programme Set mode, the channel select buttons are inoperative.
3. Press the SELECT button ㉜ , and then "1st SUN" will start flashing.
4. Press the SET button ㉝ to specify the day.
    - Pressing it once advances the indication by one day and holding it pressed advances the indication rapidly.
    - The sequence of indication changing is: from SUN to SAT of the 1st week, then from SUN to SAT of the 2nd week, then everyday from SUN to SAT of the 1st week, then returning to the original condition.
5. Press the SELECT button ㉜ , and then the "hour" digit will begin flashing.
6. Press the SET button ㉝ to obtain a desired hour indication.
7. Press the SELECT button ㉜ , and then the "minute" digits will begin flashing.
8. Press the SET button ㉝ to specify a desired minute indication.
9. Press the SELECT button ㉜ , and the REC LENGTH digits will begin flashing.
10. Press the SET button ㉝ to obtain a desired recording length.
    - The recording length can be set within 395 minutes in 5-minute steps.
11. Now you have finished presetting the timer for program "1". If you need to enter another preset programme, press the PROG NO button ㉒ , and "2" will be displayed on the PROGRAM NO indicator ㉔ for the next programme setting. You can follow the same procedure as instructed above.
12. When you have finished all necessary presettings to future programmes, set the CLOCK button ⓳ to return to the Clock mode.
13. After having programmed the timer, be sure to load a cassette, make sure that the REC SELECT switch (57) is set to TUNER and set the sub-power switch ❶ to TIMER following the instructions given below.

Repeating the preset programmes

- Normally the preset data are cleared after a recording has been made accordingly. However, if you wish to hold the preset data in memory in order for recordings to be made repeatedly according to this same data (for example, at the same time on the same day every week), press the PROG REPEAT button ㉑ . The programme repeat indicator ㉕ will light.

Cancelling the preset programmes

- The preset programmes can be cancelled by pressing the CANCEL button ㉓ after calling up the corresponding programme number on the display.
- If you wish to cancel all preset data for programmes 1 through 8, press the CANCEL button ㉓ while simultaneously holding the PROG NO button ㉒ . Then all programmes will be cleared and programme No. 1 will be displayed.

Notes

- During the Programme Set mode, if no command is entered within two minutes, the Clock mode will be automatically engaged. If you have not yet finished setting the programme, press the PROG SET button once again.
- The preset data can be called up any time for checking by engaging the Programme Set mode and calling up the relevant programme number.
- If you wish to change the preset data partially, press the SELECT button in the Programme Set mode until the corresponding item starts flashing on the display and enter the new data by pressing the SET button.
- It is impossible to alter the programmed data (except the recording length) during actual timer recording.
- The recording length can be changed even during timer recording by using the SELECT and SET buttons in the Programme Set mode.
- If a power failure should occur (and last longer than about 10 minutes), not only time-keeping stops (see page 17), but also all the preset data will be cancelled. A flashing SUN 0:00 indicates this after power has been reapplied. In such cases, first correct the time indication and then reenter the programming data.

HOW TO SET THE RECORDER FOR UNATTENDED RECORDING

After having programmed the timer, prepare the recorder section for unattended recording.

1. Set the sub-power switch ❶ to ON.
2. Load a cassette.
    - Make sure that the tape length is sufficient for the sum of your intended recordings.
    - Make sure that the safety tab of the cassette is in place.
3. Make sure that the REC SELECT switch (57) is set to TUNER.
4. Set the sub-power switch ❶ to TIMER.
    - If the safety tab of the cassette has been removed, the cassette is automatically ejected when the sub-power switch is set to TIMER.

Now preparations for unattended recording are complete; when the preset switch-on time is reached, recording will start automatically. There is no need to press the REC and PLAY buttons to engage the Recording Standby mode.

Notes

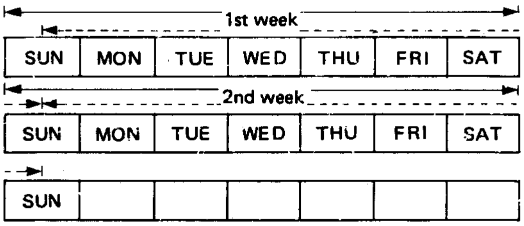
- Tape loading starts 10 seconds before the preset switch-on time and recording starts exactly at the preset time.
- If the end of the tape is reached during timer recording, the auto rewind mechanism does not function and the cassette is automatically ejected.
- After the unattended recording has been made, set the sub-power switch to OFF.

FOR A BETTER UNDERSTANDING OF THE PROGRAMMABLE TIMER

Two-week timer

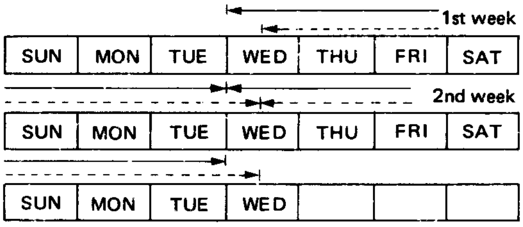
"Two-week" presetting capacity means that you can "reserve" recordings on any one of 14 days in advance including the day of setting.

If the current day of setting is Sunday:



- In this situation, there may be no possibility of confusion in setting the day.
- Namely, the "1st MON" is Monday of the current week and the "2nd MON" is Monday of the next week. The same applies to other week days.
- Regarding Sunday, there are two different cases; one is that you are going to set the timer to a time before the current time of setting and the other is that the preset time is a time after the current time of setting.
- In the former case, the "1st SUN" is the next Sunday and the "2nd SUN" is the Sunday after next.
- In the latter case, the "1st SUN" is the current Sunday and the "2nd SUN" is Sunday of the next week.

If the current day of setting is Wednesday for example:



- Remember that the "1st MON", "1st TUE" and so on . . . mean the first coming Monday, the first coming Tuesday, and so on, and not Monday of the current week.
- Similarly, the "2nd MON", "2nd TUE" and so on . . . are the second coming Monday, the second coming Tuesday, and so on, and not Monday or Tuesday of the next week.
- If you are on Wednesday for example, and wish to record something on Tuesday of the next week, the preset data should be "1st,TUE". To record on Thursday of the next week, set "2nd THU".
- Regarding Wednesday, the same as mentioned about Sunday on the left applies.

8-programme timer

"8-programme" presetting capacity means that you can have 8 separate programme entries which contain different programming data. Because of this capacity, you can even "reserve" 8 different TV programmes, either on the same day or on different days.

Each programme (No. 1 through No. 8) entry contains information on "TV programme channel number", "day", "switch-on time", "recording length" and "either single or repeat".

Example of the contents of one programme entry:

Programme number	TV programme channel number	Day	Switch-on time	Recording length	Repeat
2	12	1st WED	2:30	30 min.	–

Variety of setting possibilities

- You can set for some day of the 1st week or the 2nd week.
- You can set for one day of every week by first setting that day of the 1st week and pressing the PROG REPEAT button.
- You can set for one day of every week starting from the second week by first setting that day of the 2nd week and pressing the PROG REPEAT button.
- You can set for all days of the 1st week. For this setting, obtain the indication "1st SUN MON TUE WED THU FRI SAT", and recordings will be repeated at the same time everyday for one week.
- You can set for all days week after week. For this setting, first obtain the indication as mentioned above and then press the PROG REPEAT button. And recordings will be made everyday week after week.
- All the above applies for all 8 programme entries.

Programme priority

- If you have preset two programmes for the same day and the same switch-on time, the setting corresponding to the smaller programme number has priority.
- If two programmes have preset times which overlap, the earlier-started programme will be interrupted by the latter one.
- When a certain preset time is reached in the Sleep Timer mode, the Sleep Timer mode has priority.

HOW TO USE THE SLEEP TIMER FACILITY

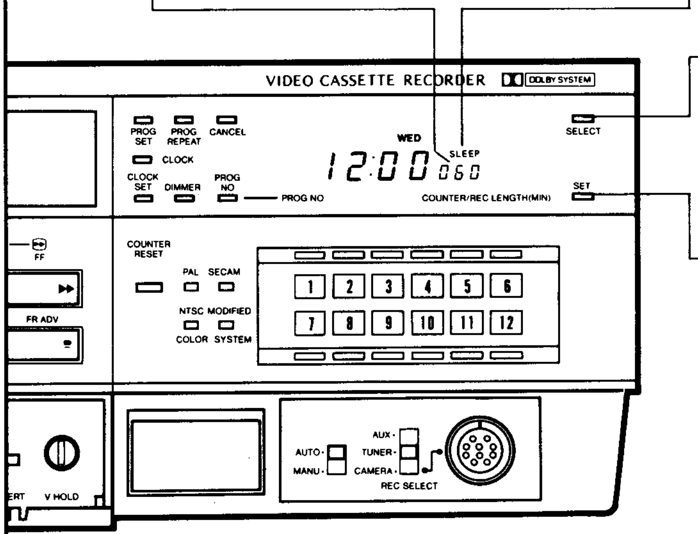
Basic guidelines

㉚ COUNTER/REC LENGTH (MIN) digits
For setting the period of time after which the power is automatically switched off.

㉛ SLEEP indicator
The word "SLEEP" is illuminated in the Sleep Timer mode.

㉜ SELECT button
Enables the REC LENGTH digits to flash so that they can be changed.

㉝ SET button
Sets the required time for the Sleep Timer mode to continue.


VIDEO CASSETTE RECORDER
DOLBY SYSTEM
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00
SLEEP
060
SELECT
SET
PROG NO
COUNTER/REC LENGTH(MIN)
FF
FR ADV
COUNTER RESET
PAL
SECAM
NTSC MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
AUX
TUNER
CAMERA
AUTO
MANU
REC SELECT
V HOLD

The built-in sleep timer facility allows recording to stop automatically after a certain period of time. Start recording in an ordinary manner, then shift the sub-power switch to TIMER and set the switch-off time.

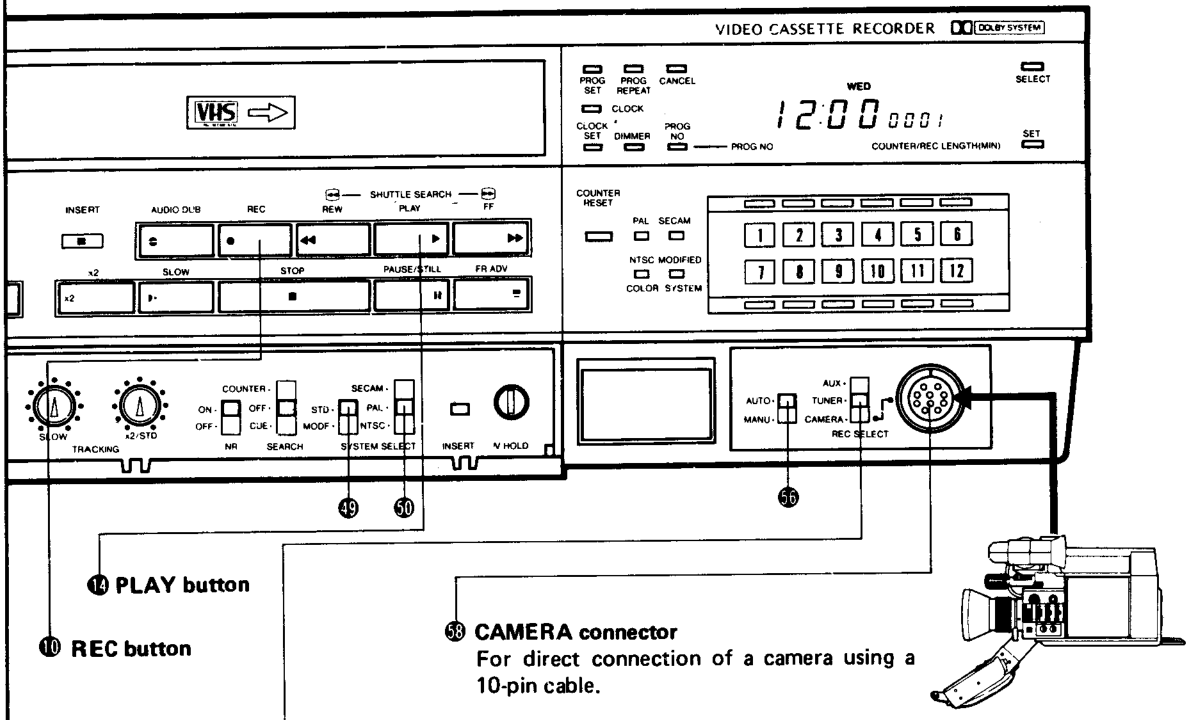
Procedure

1. Set the sub-power switch ❶ to ON.
2. Load a cassette.
   - Make sure that the safety tab of the cassette is in place.
3. Start recording in the manner described before.
4. Shift the sub-power switch ❶ to TIMER.
   - The SLEEP indicator ㉛ will be illuminated and the figures "060" will appear on the REC LENGTH indicator. This means that power will be switched off automatically after 60 minutes.
5. If you want to change the length of time, press the SELECT button ㉜ .
   - The digits will start flashing.
6. Press the SET button ㉝ to obtain a desired length of time.
   - The length of time can be set within 395 minutes in 5-minute steps.
7. Press the SELECT button ㉜ once again, and the digits will stop flashing and the Sleep Timer mode will be engaged.

After a preset time, power will be switched off automatically. If the end of the tape is reached during recording in the Sleep Timer mode, the automatic rewind mechanism does not function and the cassette is automatically ejected.

HOW TO RECORD WITH A VIDEO CAMERA

Basic guidelines


VIDEO CASSETTE RECORDER
VHS
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00 0001
SELECT
SET
PROG NO
COUNTER/REC LENGTH(MIN)
SHUTTLE SEARCH
INSERT
AUDIO DUB
REC
REW
PLAY
FF
x2
SLOW
STOP
PAUSE/STILL
FR ADV
COUNTER RESET
PAL
SECAM
NTSC MODIFIED
COLOR SYSTEM
1
2
3
4
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6
7
8
9
10
11
12
SLOW
x2/STD
TRACKING
COUNTER
ON
OFF
OFF
CUE
NR
SEARCH
STD
MODF
SECAM
PAL
NTSC
SYSTEM SELECT
INSERT
V HOLD
AUTO
MANU
AUX
TUNER
CAMERA
REC SELECT
㊾
㊿
(56)

⑭ **PLAY button**

⑩ **REC button**

(58) **CAMERA connector**
For direct connection of a camera using a 10-pin cable.

(57) **REC SELECT switch**
Setting to CAMERA enables signals from the camera connected to the CAMERA connector to be recorded.

When a camera is connected to the CAMERA connector and the REC SELECT switch is set to CAMERA, it is powered through the recorder and scenes being shot by the camera will appear on the TV screen.

Procedure

1. Connect a camera.
2. Press the sub-power switch ① to ON.
3. Switch on the TV receiver.
4. Set the TV receiver's channel selector to your VIDEO CHANNEL.
5. Set the REC SELECT switch (57) to CAMERA.
   - You can monitor the scenes being shot by the camera.
6. Load a cassette.
7. Press the REC and PLAY buttons ⑩ ⑭ simultaneously. The recorder enters the Recording Standby mode.
   - When a camera is connected, starting or stopping of the tape is remote-controlled by the camera. Therefore, pressing the REC and PLAY buttons does not yet start the tape-running operation.
8. Operate the camera's start/stop switch. Now recording will start.

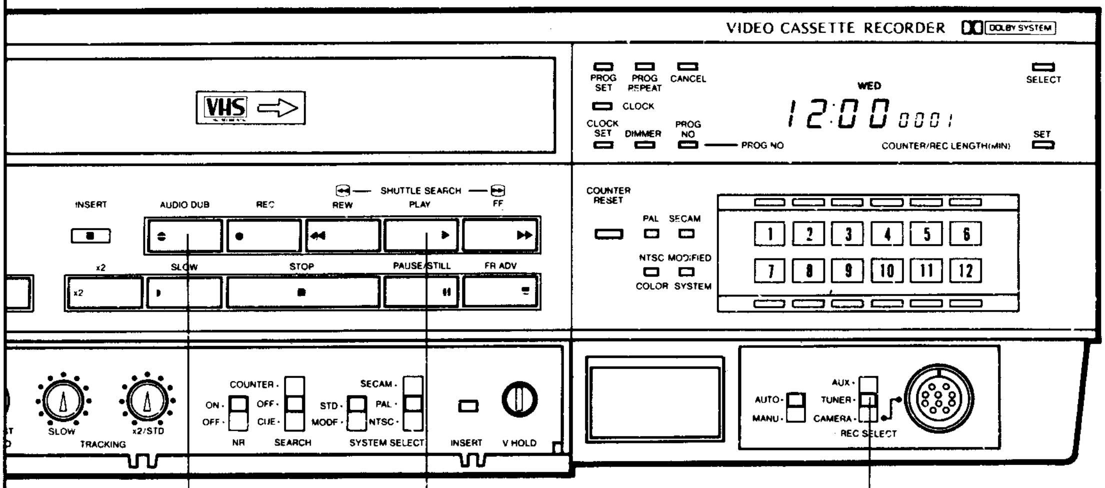
Notes

- If feedback noise (whistling or howling) is heard from the TV receiver, reduce the volume or move the microphone, either external or built within the camera, farther away from the TV receiver.
- Power to the camera is switched on or off with the sub-power switch or by using the built-in timer.
- With some cameras, their battery warning indicator may flicker, however, no problem occurs with recording as long as the picture being monitored on the TV screen appears normal.

Confirm the signal system of the camera being used and set the SYSTEM SELECT switches ㊾ , ㊿ and (56) correctly to suit the camera.

HOW TO PERFORM AUDIO DUBBING

Basic guidelines


VIDEO CASSETTE RECORDER
DOLBY SYSTEM
VHS
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00 0001
PROG NO
COUNTER/REC LENGTH(MIN)
SELECT
SET
INSERT
AUDIO DUB
REC
SHUTTLE SEARCH
REW
PLAY
FF
x2
SLOW
STOP
PAUSE/STILL
FR ADV
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
SLOW
x2/STD
TRACKING
COUNTER
ON
OFF
OFF
CUE
NR
SEARCH
SECAM
STD
MODF
PAL
NTSC
SYSTEM SELECT
INSERT
V HOLD
AUX
AUTO
MANU
TUNER
CAMERA
REC SELECT

⑨ AUDIO DUB button
To start audio dubbing.

⑭ PLAY button

(57) REC SELECT switch
Setting to AUX enables signals from audio equipment connected to the rear panel AUDIO connector to be recorded.

Audio dubbing means recording a sound track on a pre-recorded cassette. Sound from a source connected to the rear panel AUDIO connector, or from a microphone connected to the front panel MIC jack, or a mixture of the two can be recorded. The previously recorded sound is erased and replaced with a new sound track by audio dubbing.

Procedure

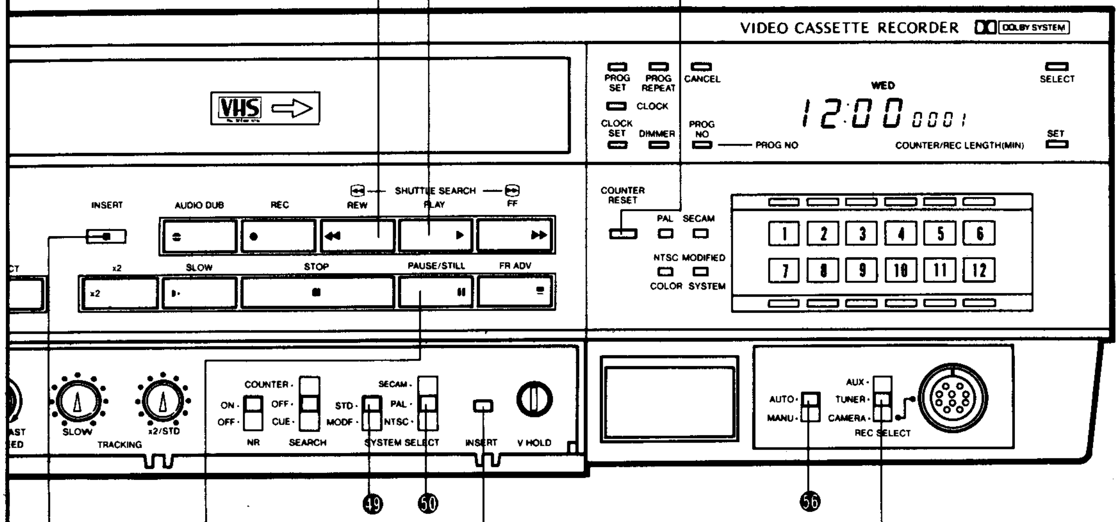
1. Load a pre-recorded cassette.
2. Set the TV receiver's channel selector to your VIDEO CHANNEL to monitor the playback picture while dubbing audio.
3. Set the REC SELECT switch (57) to AUX.
   - If you record sound only from the microphone, this switch has no effect and may be in any position.
4. Press the AUDIO DUB and PLAY buttons ⑨ ⑭ simultaneously. The AUDIO DUB and PLAY indicators will light and audio dubbing will start.

Notes

- Use a high-impedance microphone.
- If whistling or howling is heard during audio dubbing, reduce the TV volume or move the microphone farther away from the TV. Recording is being performed even if sound is not heard from the TV receiver. If you want to monitor the sound being recorded, connect an earphone to the TV receiver.
- The pause function facilitates audio dubbing. First play back the pre-recorded tape and press the PAUSE/STILL button at the point from which you wish to start audio dubbing. If necessary, adjust the point by using the FR ADV button. Then press the AUDIO DUB and PLAY buttons simultaneously. This permits you to start audio dubbing exactly at the right point.
- Even though you are playing back the tape in the Double-Speed (X2) mode, normal speed is automatically resumed when the Audio Dub mode is engaged.

HOW TO PERFORM INSERT EDITING

Basic guidelines


VIDEO CASSETTE RECORDER
DOLBY SYSTEM
VHS
PROG SET
PROG REPEAT
CANCEL
CLOCK
CLOCK SET
DIMMER
PROG NO
WED
12:00 0001
SELECT
PROG NO
COUNTER/REC LENGTH(MIN)
SET
INSERT
AUDIO DUB
REC
REW
SHUTTLE SEARCH
PLAY
FF
x2
SLOW
STOP
PAUSE/STILL
FR ADV
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
SLOW
x2/STD
TRACKING
COUNTER
ON
OFF
OFF
CUE
NR
SEARCH
STD
MODF
SECAM
PAL
NTSC
SYSTEM SELECT
INSERT
V HOLD
AUTO
MANU
AUX
TUNER
CAMERA
REC SELECT
⑫
⑭
(53)
⑬
㊺
㊾
㊿
(51)
(56)
(57)

⑫ **REW/SHUTTLE SEARCH button**

⑭ **PLAY button**

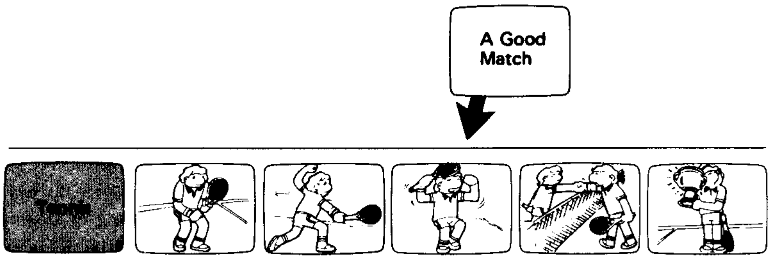
(53) **COUNTER RESET button**

⑬ **PAUSE/STILL button**

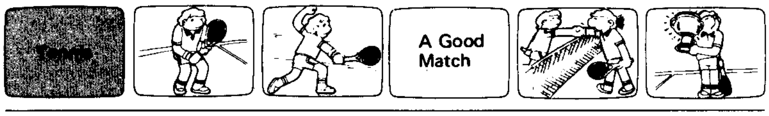
(51) **INSERT button**
Engages the Insert Edit mode.

(57) **REC SELECT switch**

㊺ **INSERT indicator**
Lights during insert editing.


A Good Match
Tennis

Original tape


Tennis
A Good Match

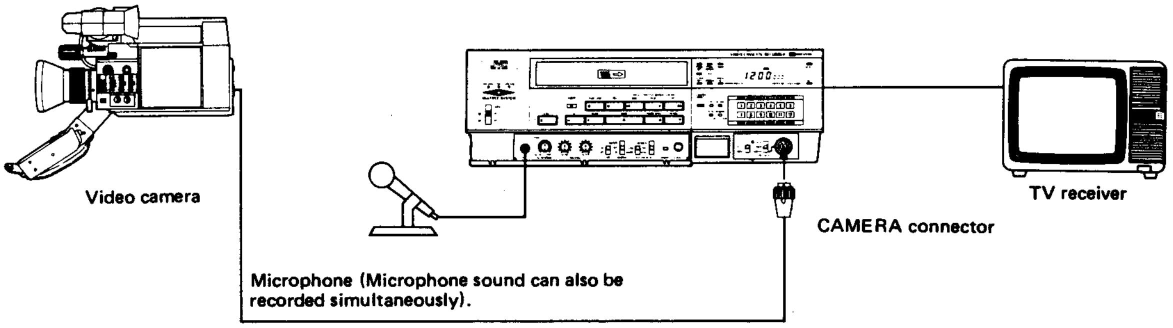
Edited tape

Insert editing means recording a new scene into a section of pre-recorded tape so that a part of the original recording can be replaced with a new one without excessive picture distortion at edit-in and edit-out points.

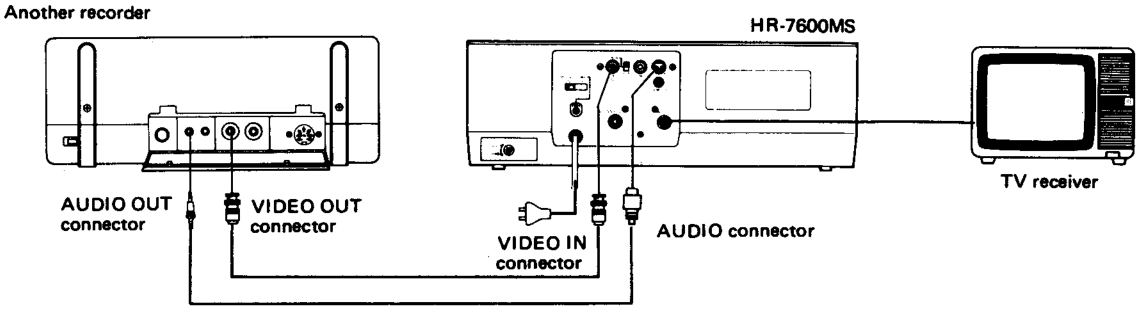
New video and audio signals to be inserted can come either from a video camera or another video cassette recorder, or even from the built-in tuner.

Connections

For inserting video and audio signals from a camera connected to the CAMERA connector.


Video camera
TV receiver
CAMERA connector
Microphone (Microphone sound can also be recorded simultaneously).

For inserting video and audio signals from another video cassette recorder.



> Satisfactory insert editing is possible only when the new signal to be inserted and the signal pre-recorded on the tape have the same signal system.

Procedure

1. Load a pre-recorded cassette.
2. Set the TV receiver's channel selector to your VIDEO CHANNEL to monitor the playback picture.
3. Set the REC SELECT switch (57) as required.
   AUX: To insert programmes from a different tape.
   TUNER: To insert TV programmes from the built-in tuner.
   CAMERA: To insert camera signals from a camera connected to the CAMERA connector.
4. Play back the tape to determine the edit-out point (the end of the tape section to be replaced).
5. Press the PAUSE/STILL button ⓭ at the edit-out point.
6. Reset the tape counter to "0000" by pressing the COUNTER RESET button [illegible] .
7. Run the tape backwards by pressing the REW/SHUTTLE SEARCH button ⓬ to determine the edit-in point (the beginning of the tape section to be replaced).
8. Press the PAUSE/STILL button ⓭ at the edit-in point.
9. Press the PAUSE/STILL button ⓭ and the INSERT button [illegible] simultaneously. This engages the Insert Standby mode in which the input signal can be monitored on the TV screen; the still picture changes into the input signal that you are going to record. The input sound signal can also be monitored. The INSERT indicator ㊺ will light.
10. Operate the source equipment properly.
    - Play back on another recorder the tape programme to be inserted.
    - Operate the camera so that it is in the running lock mode.
    - Select the channel to be recorded with the corresponding channel select button.
11. Press the PLAY button ⓮ to start insert editing. Now video and audio signals will be recorded simultaneously.
12. At the counter reading of "0000", recording will stop automatically and the INSERT indicator will turn off.
13. The tape will continue running in the Play mode.

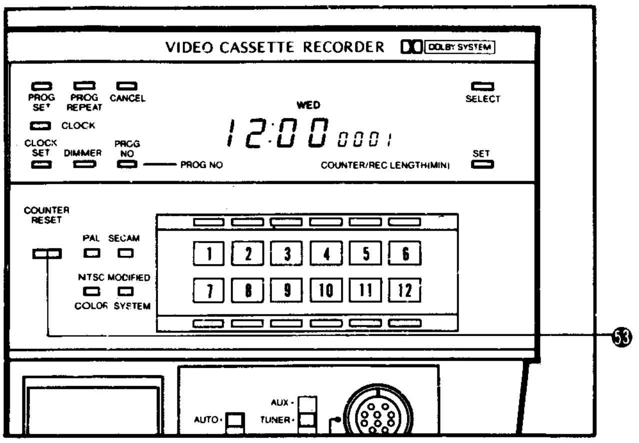
Notes

- Do not use the STOP button to stop insert editing. If you press the STOP button, the tape stops and the Insert Edit mode is cancelled.
- If there happens to be a non-recorded segment on the pre-recorded tape on which you are going to insert new material, the picture will be distorted temporarily at this segment during playback.
- The insert edit is not of the professional type. Therefore the results very much depend on the previously recorded signal, whether colours are stable or fluctuate slightly. This is not due to any defect of the unit.
- Do not repeat insert editing onto the same section of the tape, as this will degrade the picture quality.

PART V

ADDITIONAL FACILITIES

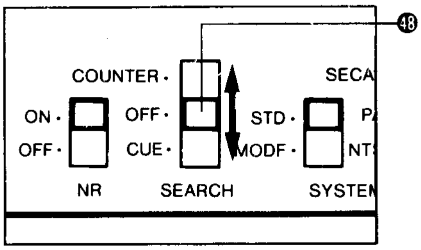
HOW TO USE THE TAPE COUNTER


VIDEO CASSETTE RECORDER
DOLBY SYSTEM
PROG SET
PROG REPEAT
CANCEL
SELECT
WED
CLOCK
12:00 0001
CLOCK SET
DIMMER
PROG NO
PROG NO
COUNTER/REC LENGTH(MIN)
SET
COUNTER RESET
PAL
SECAM
NTSC
MODIFIED
COLOR SYSTEM
1
2
3
4
5
6
7
8
9
10
11
12
(53)
AUX
AUTO
TUNER

The tape counter is helpful for tape indexing. When the sub-power switch ① is set to ON, the display shows the tape counter beside the clock time.

- The tape counter functions in all tape modes.
- Pressing the COUNTER RESET button (53) resets the counter reading to nearly "0000".
- When used in conjunction with the SEARCH switch (48) counter search function is available (see next chapter).

HOW TO USE THE SEARCH SWITCH


(48)
COUNTER
SECA
ON
OFF
OFF
CUE
STD
MODF
P
NT
NR
SEARCH
SYSTE

To search for a specific tape section, you can apply either the Counter Search or Cue Search mode.

Counter search

When the SEARCH switch (48) is set to COUNTER, the point corresponding to the counter reading of nearly "0000" is automatically located in the Fast Forward or Rewind mode. Therefore, its typical use may be: (1) press the COUNTER RESET button at the start of playback and (2) after playback, rewind the tape. Then the tape automatically stops when the counter reaches nearly "0000", facilitating the location of the tape section you want to play back again.

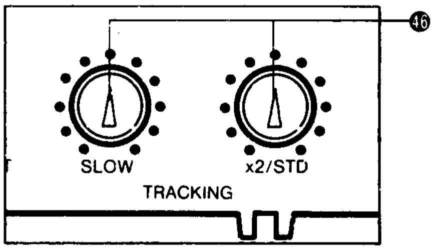
Cue search

At the beginning of every recording, a cue signal is recorded on the tape. The cue search function enables the sensing of this cue signal and stops the tape at a point where a new recording was made. Similarly to the counter search function, this mode is applicable only in the Fast Forward and Rewind modes. If you wish to view the recorded material immediately after it was made, set the SEARCH switch (48) to CUE. After recording, if you rewind the tape, it stops automatically where the recording was initiated (the cue signal position).

Notes

- The cue signal is recorded in the following cases:
  (1) When a recording is initiated from the Stop mode (STOP to REC).
  (2) When a timer recording is initiated (TIMER ON to REC).
  (3) When a recording is initiated from the Play mode by pressing the PLAY button together with the REC button (PLAY to REC).

HOW TO USE THE TRACKING CONTROL

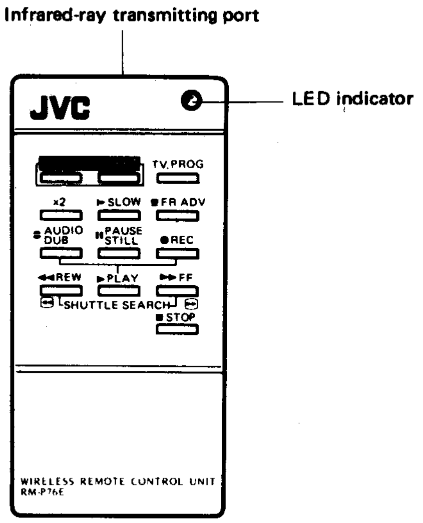

(46)
SLOW
x2/STD
TRACKING

If the playback picture contains noise bars (this is likely to happen when you play back a cassette which was recorded with a different video recorder unit), adjust the TRACKING controls (46), X2/STD control during playback at normal and double-speed and SLOW control during slow-motion playback. Turn it slowly in either direction until the noise bars are minimized on the screen.

Note

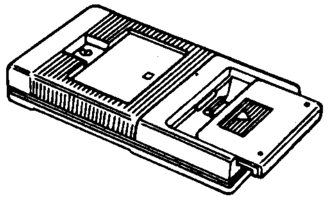
After playing back that particular cassette, be sure to return the TRACKING controls to their centre position.

HOW TO USE THE REMOTE CONTROL UNIT

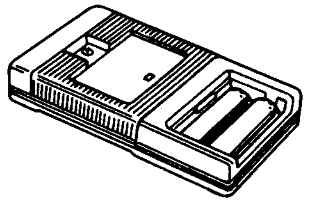


Installing the batteries

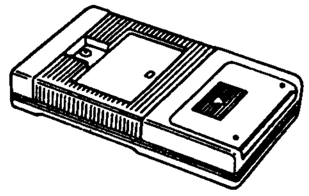
1. Slide the battery compartment cover on the rear of the unit in the direction of the arrow (►).



2. Insert 2 "R6"-size batteries (provided) in the correct directions into the battery compartment.



3. Replace the cover.



- If the LED indicator fails to light when one of the buttons is pressed after the remote control unit has been used for a long time, the battery power is insufficient. Replace all 2 batteries with fresh ones following the instructions.

Features

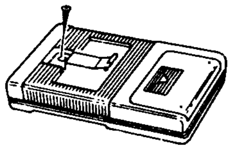
- This remote control employs infrared-ray transmission.
- Main operational buttons on the recorder are duplicated on the remote control unit for at-a-distance operation.
- This remote control can operate the recorder from a distance of up to 10 m.
- All tape control modes (except EJECT) and TV programme channel selection are possible via the remote control unit.
- There is no possibility of cross-modulation or mis-operation from other infrared remote control units.

Operation

- Direct the infrared-ray transmitting port toward the recorder's receiving window.
- The function of each button is exactly the same as that of the corresponding button on the recorder.
- For TV programme channel selection, press the TV. PROG button a number of times.
- The LED indicator on the remote control unit lights to indicate that it is transmitting a signal.
- If some channels are skipped, you don't have to press the TV. PROG button of the remote control unit a number of times to reach your desired channel.

Notes

- Do not attempt to press two buttons simultaneously (except PLAY and REC or PLAY and AUDIO DUB), otherwise malfunctioning may result.
- When you have switched the power off via the remote control unit, even though the recorder's sub-power switch is in the ON position, the recorder is inoperative (with the power indicator turned off). To re-apply power to the recorder, either press the ON button on the remote control unit or first set the recorder's sub-power switch to OFF and then set it to ON once again.
- The metal latch provided permits the remote control unit to be hooked onto various places. Attach it as illustrated.



Specifications

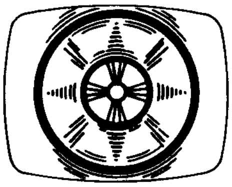
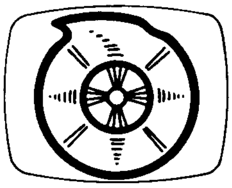
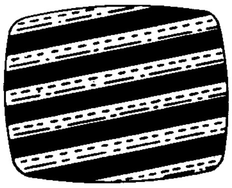
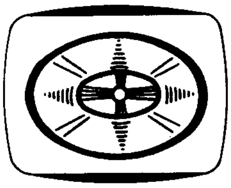
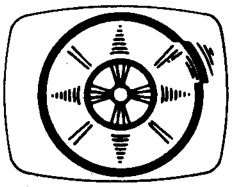
Power supply	: DC 3 V ("R6" battery x 2)
Dimensions	: 63 mm(W) x 130 mm(H) x 21 mm(D)
Weight	: 120 g(incl. batteries)
Operating distance	: 10 m max.

PART VI

SUPPLEMENTS

ADJUST YOUR TV RECEIVER WHEN ...

Speed or Still Playback may require adjusting your TV receiver. If your TV receiver shows the following symptoms during Speed Playback or Still Playback using the HR-7600MS, adjust the TV receiver first.

Symptom	Adjustment
Picture vibrates vertically. 	Turn the V-Hold knob slightly for stabilizing.*
The upper portion of the picture drifts horizontally. 	Turn the H-Hold knob slightly for stabilizing.**
Picture rolls. 	Turn the H-Hold knob slightly for stabilizing.**
Picture is flattened vertically. 	Inherent in your TV receiver.
Only a portion of the picture continues to flicker. 	Not adjustable. Inherent in your TV receiver.

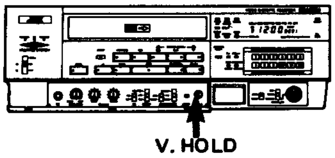
HEAD CLEANING

- Picture playback may become blurred or interrupted while the TV programme received is clear. This does not mean that the recorded programme has been erased.
- Dirt accumulated on the head after long periods of use causes such troubles. In this case, head cleaning requiring highly technical care is necessary.

*For head cleaning, consult the nearest JVC dealer.

If the V-Hold and H-Hold knobs are not provided on your TV receiver, please consult your JVC dealer.

*If an unsatisfactory result is obtained, adjust the V. HOLD knob located on the sub-control panel of the unit so that a stable picture is obtained.



** If an unsatisfactory result is obtained, it is necessary to adjust the AFC circuit of the TV receiver.

IN CASE OF DIFFICULTY

What may initially appear to be trouble is not always a real problem. Make sure first . . .

Symptoms	Check points
[redacted]	
Clock is functioning properly, but the set is not powered with the recorder's sub-power switch set to ON.	● Have you switched the power off last via the infrared remote control unit? – If so, set the recorder's sub-power switch to OFF once and then set it to ON again. – Or simply press the remote control unit's ON button.
[redacted]	
REC or AUDIO DUB button cannot be pressed in.	● Is the safety tab on the video cassette broken? – Reseal the slot with cellophane tape.
[redacted]	
Buttons for variable-speed playback do not function.	● Have you pressed the PLAY button first? – If not, press it.
[redacted]	
No colour or rolling picture.	● Is the video mode select switch (on the rear panel) set to COLOUR? ● Are the SYSTEM SELECT switches set correctly? (See page 7.)
[redacted]	
Channel cannot be changed during pretuning.	● Have you turned the tuning control while the indicator is still blinking? – If so, you cannot select any other channel. See page 16.

SPECIFICATIONS

General

Power requirement : 110/127/220/240 V AC, 50/60 Hz
Power consumption : 45 watts (60 W with camera)
Camera connector output : DC 12 V ⎓ 1 A max.
Temperature : Operating: 5°C to 40°C
Storage: -20°C to 60°C
Operating position : Horizontal only
Weight : 12 kg
Dimensions : 460(W) x 154(H) x 371(D) mm

Tape deck section

Format : VHS standard
Video signal system : PAL and SECAM colour and CCIR monochrome signal, 625 lines
NTSC colour and EIA monochrome signal, 525 lines
Video recording system : Luminance: FM recording
Colour: Phase shift & converted subcarrier direct recording (PAL/NTSC)
1/4 frequency count down and direct recording (SECAM)
Scanning system : Rotary, slant azimuth, two-head helical scan system
Tape width : 12.65 mm
Tape speed : 23.39 mm/sec (PAL/SECAM)
33.35 mm/sec (NTSC)
Playing time : 240 minutes with E-240 (PAL/SECAM)
Video input : 0.5 to 2.0 Vp-p/75 ohms
Video output : 1.0 Vp-p 75 ohms
Video S/N : 43 dB (with Rohde & Schwarz noise meter)
Resolution of picture : More than 250 lines
: More than 240 lines (NTSC/SECAM)
Audio mic input : -67 dBs/high impedance, unbalanced
Audio line input : -20 dBs/50 k-ohms, unbalanced
Audio output level : -6 dB, high impedance load
Audio output impedance : 1 k-ohm, unbalanced
Audio frequency range : 70 Hz – 12 kHz
Audio S/N : More than 48 dB (Noise reduction on)

TV tuner/RF section

Channel storage capacity : 12 channels
Aerial input : VHF band I, channels 2 – 4
VHF band III, channels 5 – 12
UHF band IV/V, channels 21 – 69
Aerial output : UHF channels 32 – 40 (Adjustable)

Digital clock/timer

Clock display : 24-hour fluorescent digital display with day indication
Reference frequency : Quartz controlled
Start time setting : Within 2 weeks
Programming capacity : 8 programmes

Accessories : Aerial cable
Video cassette
Infrared remote control unit
"R6" battery x 2
Metal latch

Optional accessory : Wired remote control unit (RM-P73U)

Design and specifications subject to change without notice.

SECTION 1
GENERAL DESCRIPTION

[1] PAL SYSTEM

1.1 GENERAL OUTLINE

The VHS system achieves very low tape consumption and uses low cost video cassette tape. Recording time in the standard mode has become 3 hours.

Increased recording time results from the narrow gap video heads, high sensitivity video tape and the slant azimuth recording head configuration which eliminates the need for a guard band between recorded tracks.
In addition, the VHS format takes into consideration special operating modes such as still picture, slow motion and speed playback. The design also allows switching over between the SECAM and NTSC television standards.

Adoption of the VHS format presented several technical challenges. Foremost among these were obtaining high picture quality and high resolution despite the slow (4.9 meters per second) relative speed between the tape and video heads, improving signal to noise ratio (S/N), and preventing black to white reversal phenomena due to the short recording wavelength of 1.0 μm. Also the $\pm 6^\circ$ azimuth angle of the video heads alone is not sufficient to eliminate crosstalk from the lowband converted color signal.

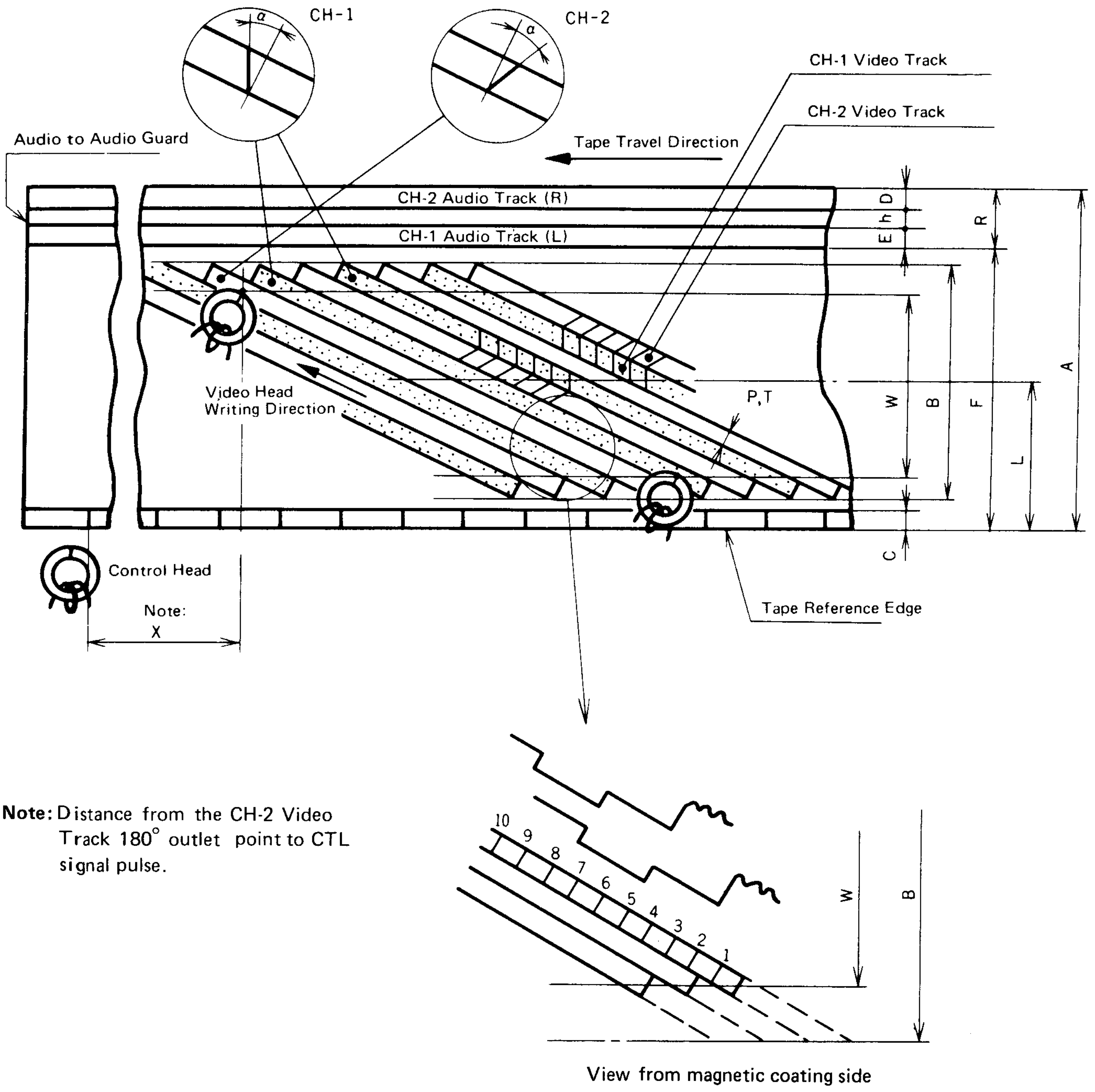
Steps for solving these difficulties included adoption of a nonlinear emphasis circuit and selecting the emphasis amount for optimum S/N. The reversal problem was overcome by using a double limiter circuit, while a phase shift system has been designed for eliminating color crosstalk.

The following discussion covers several main points of the VHS format.

1.2 MAGNETIC TAPE PATTERN

1.2.1 Standard

In the VHS format, two rotating video heads at ±6° azimuth angle are used for recording without a guard band. Fig. 1-1 indicates the recording pattern, while the pertinent values are listed in Table 1-1.


CH-1
α
CH-2
α
CH-1 Video Track
CH-2 Video Track
Audio to Audio Guard
Tape Travel Direction
CH-2 Audio Track (R)
CH-1 Audio Track (L)
D
h
E
R
A
W
B
F
L
P,T
C
Video Head
Writing Direction
Control Head
Note:
X
Tape Reference Edge
10
9
8
7
6
5
4
3
2
1
W
B
View from magnetic coating side

Note: Distance from the CH-2 Video Track 180° outlet point to CTL signal pulse.

Fig. 1-1 Magnetic tape pattern

Items		Standard	Remarks
1. (A) Tape Width	mm	12.65 ± 0.01	
2. (Vt) Tape Speed	mm/sec	23.39 ± 0.5%	
3. (ϕ) Drum Diameter	mm	62 ± 0.01	(Upper Drum)
4. (Vh) Writing Speed	m/sec	4.85	
5. (P) Video Track Pitch	mm	0.049	
6. (B) Video Width	mm	10.60	
7. (W) Video Effective Width	mm	10.07	
8. (L) Video Track Center	mm	6.2	Measured from reference edge
9. (V) Video Track Width	mm	0.049	
10. (C) Control Track Width	mm	0.75	
11. (R) Audio Track Width	mm	1.0	Single track
12. (D) Audio Track Width	mm	0.35	CH-2 (R)
13. (E) Audio Track Width	mm	0.35	CH-1 (L)
14. (F) Audio Track Reference Line	mm	11.65	Measured from reference edge
15. (h) Audio to Audio Guard Width	mm	0.3	
16. (θo) Video Track Angle		5° 56′ 7.4″	(Stopped)
17. (θ) Video Track Angle		5° 57′ 50.3″	(Running)
18. (α) Video Head Gap Azimuth Angle		6° ± 10′	
19. (X) Positions of Audio and Control Head	mm	79.244	
20. ( ) Positions of Front Edge of V-SYNC		5 ~ 8H	Inside the W bottom edge
21. ( ) Tape Back-Tension		30 ~ 45 g	At tape beginning and at the drum entrance

Table 1-1 Magnetic tape pattern

Note: Tests and measurements shall be made under the following conditions.
Temperature: 20°C ± 2°C, Relative humidity: 65% ± 5%

1.2.2 Horizontal correlation

The azimuth head configuration removes crosstalk from most of the high frequency portion of the FM luminance signal, however, it is not able to fully eliminate crosstalk from the low frequency component of the lower side-band portion. This residual crosstalk is reduced by employing line correlation for the tape pattern.

Line correlation (or "H correlation") consists of arranging the horizontal sync signal positions of adjacent recorded tracks. Since this makes the frequencies of the main signal and crosstalk signal very close, the demodulated crosstalk amount becomes extremely low with respect to the main signal. The type of H correlation used in the VHS format is shown in Fig. 1-2.

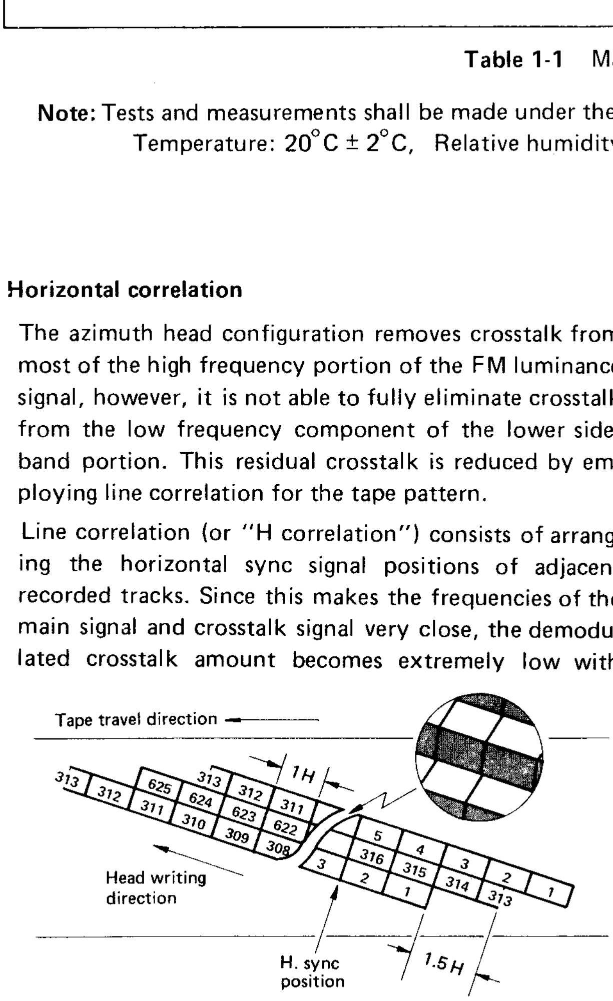


Fig. 1-2 VHS recording signal pattern

In order to provide H correlation in the tape pattern, tape speed, head drum diameter and other factors must be decided. The adjacent track correlation in the VHS format is 1.5 H. This 1.5 H difference is important not only for removing low frequency crosstalk from the luminance signal, but also for correcting color signal crosstalk in the SECAM system, for which phase shifting cannot be used.

Another advantage of H correlation is in avoiding skew distortion effects during special operating modes such as still, slow motion, 2x speed and shuttle search, when each video head traces two or more tracks. In these modes, the horizontal sync signals become played back at fixed intervals.

1.3 LUMINANCE SIGNAL RECORDING SYSTEM

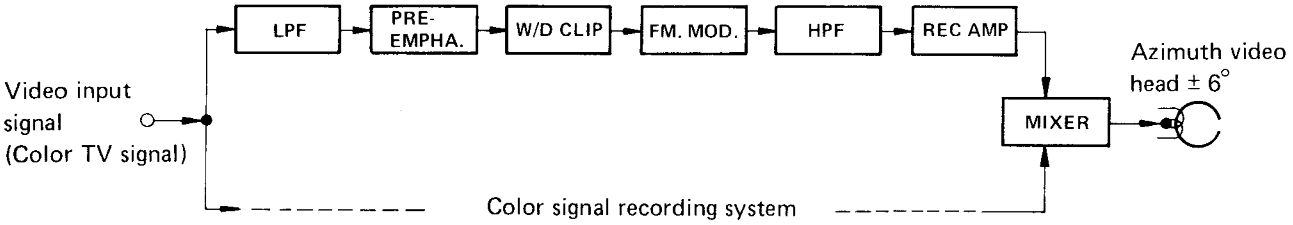


Fig. 1-3 Luminance signal recording system

Frequency modulation (FM) is used for the luminance signal recording system. A simplified block diagram of the system is shown in Fig. 1-3.

A lowpass filter (LPF) removes the color component and passes only the luminance component of the input color TV signal. At the next stage pre-emphasis circuit, the high frequency portion of the luminance signal is enhanced in order to improve S/N during FM recording. Since excess pre-emphasis could lead to black/white reversal due to the shortened recording wavelength, a white/dark clip circuit cuts the overshoot and undershoot components which exceed certain positive and negative levels.

The frequency modulator (FM MOD) converts the AM luminance signal to FM, which goes through a highpass filter (HPF) to the recording amplifier. These circuits amplify the signal with the proper frequency characteristic, after which it is mixed with the down converted color signal and supplied to the video heads.

1.3.1 Luminance signal recording frequency characteristic (LPF)

As shown in Fig. 1-4, when the video input is a color TV signal, a lowpass filter removes the color component and the luminance signal, with a bandwidth of from about 30 Hz to 3.0 MHz, is used. With some VHS models, when the input is a black and white TV signal, it bypasses the LPF, allowing a wider bandwidth to beyond 4 MHz.

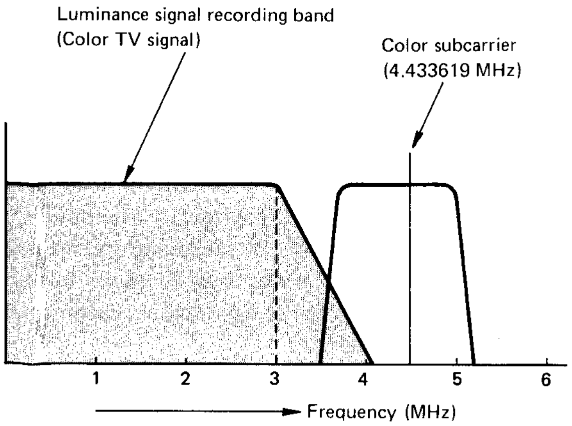


Fig. 1-4 Luminance signal recording band

1.3.2 Pre-emphasis characteristics

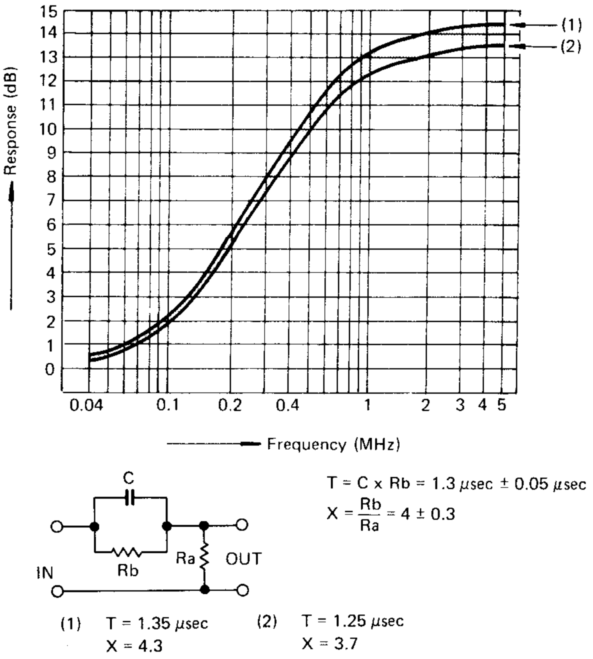


Fig. 1-5 Pre-emphasis characteristics

1.3.3 White and dark clip level (See Fig. 1-6.)

White clip level : 160^{+10}_{-50}% measured from sync tip

Dark clip level : 40 ± 10% measured from sync tip

Note: The level from sync tip to white peak is 100%.

1.3.4 FM carrier frequency and deviation (See Fig. 1-6.)

Sync tip : 3.8 ± 0.1 MHz
White peak : 4.8 ± 0.1 MHz
Deviation : 1.0 ± 0.1 MHz

1.3.5 FM signal recording frequency (HPF)

As indicated in Fig. 1-6, when the video input is a color TV signal, it goes through an HPF for vacating the area for the down converted color signal. With some VHS models, when the input is a B/W TV signal, the HPF can be bypassed to extend the bandwidth to the DC area.

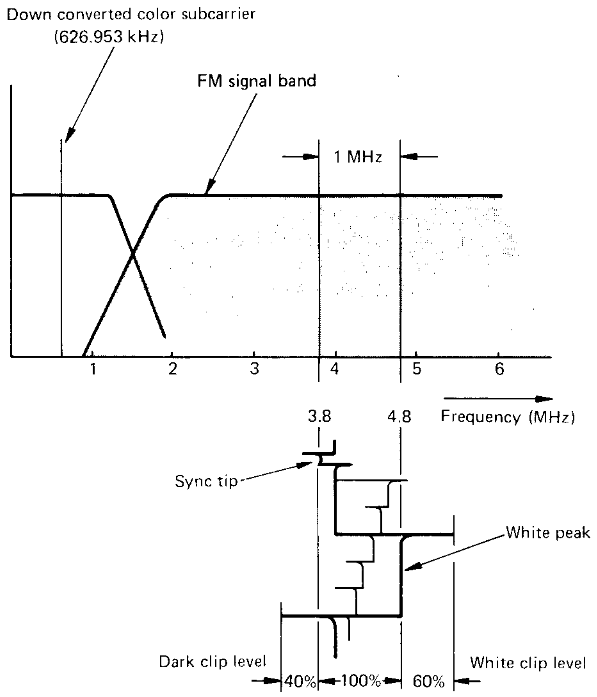

Down converted color subcarrier
(626.953 kHz)
FM signal band
1 MHz
1
2
3
4
5
6
3.8
4.8
Frequency (MHz)
Sync tip
White peak
Dark clip level
White clip level
40%
100%
60%

Fig. 1-6 Recording spectrum

1.3.6 FM signal recording amp. characteristics (REC AMP)

Current:

More than 3.8 MHz: Optimum saturation recording current
2 MHz : 3 ± 1 dB
1 MHz : 6 ± 1 dB
Less than 1 MHz : Flat characteristics

Note: 0 dB at 3.8 MHz

1.3.7 FM signal head current (VIDEO HEAD)

It shall be within ±1.5 dB of 4 MHz optimum recording current.

1.4 LUMINANCE SIGNAL PLAYBACK SYSTEM

This system functions to return the signals recorded on the tape to a form as close as possible to the video input signals. The simplified block diagram is shown in Fig. 1-7.

The low level FM signals played back by the two video heads are combined into a single FM signal by the switching amplifier. After amplification to the required frequency characteristic, a highpass filter attenuates the down converted color signal and passes only the FM luminance signal. This HPF has the same response as that of the recording system.

Variations in the playback FM signal level due to mechanical stretching and contraction of the tape, and irregularities in tape to head contact, are corrected by the limiter circuit. The signal is amplified more than 80 dB to permit precise demodulation. A double limiter circuit is employed in order to prevent black/white reversal effects.

In the following stages, the demodulator and lowpass filter return the luminance signal to its AM form. The de-emphasis circuit reverses the emphasis applied during recording. From this point, the signal goes to the mixer where it is mixed with the playback color signal to become the video output siganl.

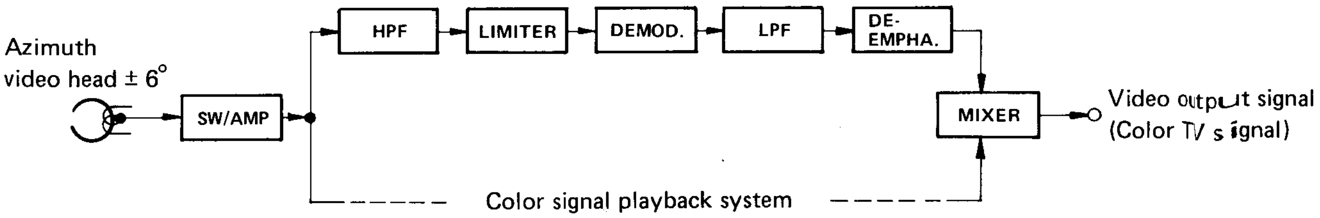
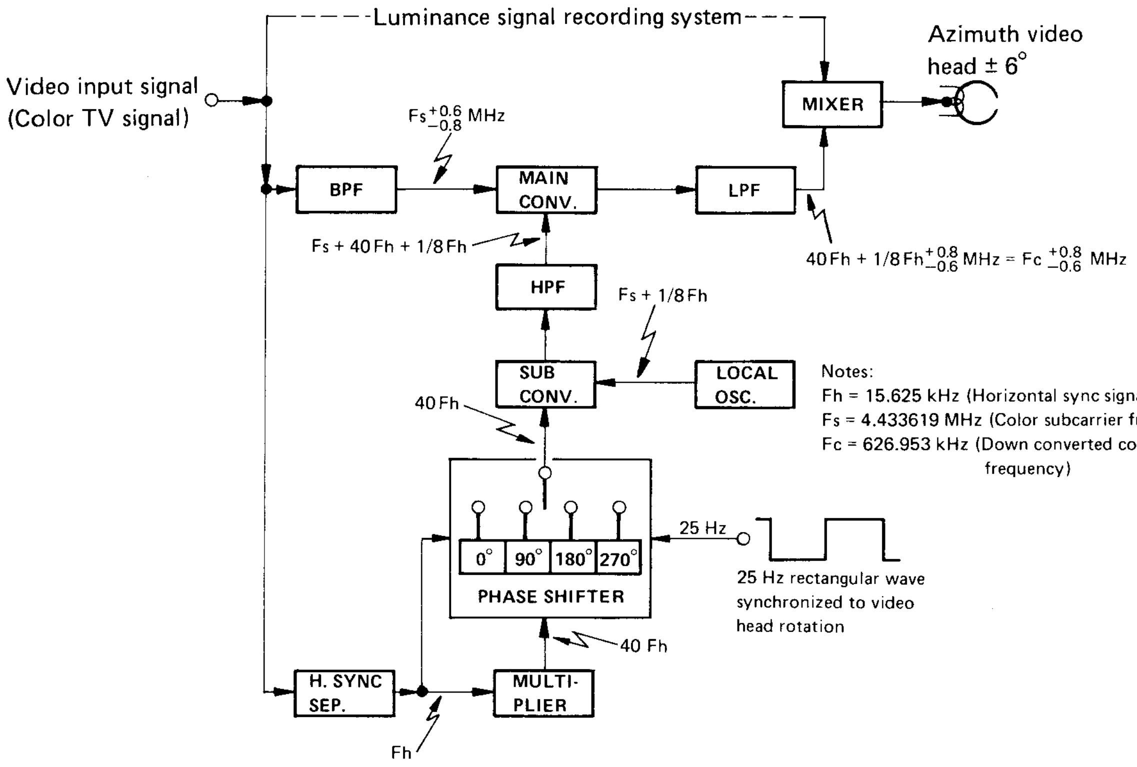

Azimuth
video head ± 6°
SW/AMP
HPF
LIMITER
DEMOD.
LPF
DE-
EMPHA.
MIXER
Video output signal
(Color TV signal)
Color signal playback system

Fig. 1-7 Luminance signal playback system

1.5 COLOR SIGNAL RECORDING SYSTEM


Luminance signal recording system
Video input signal (Color TV signal)
Azimuth video head ± 6°
MIXER
$Fs^{+0.6}_{-0.8}$ MHz
BPF
MAIN CONV.
LPF
Fs + 40 Fh + 1/8 Fh
$40Fh + 1/8Fh^{+0.8}_{-0.6}$ MHz = $Fc^{+0.8}_{-0.6}$ MHz
HPF
Fs + 1/8 Fh
SUB CONV.
LOCAL OSC.
40 Fh
0°
90°
180°
270°
PHASE SHIFTER
25 Hz
25 Hz rectangular wave synchronized to video head rotation
40 Fh
H. SYNC SEP.
MULTI-PLIER
Fh

Notes:
Fh = 15.625 kHz (Horizontal sync signal frequency)
Fs = 4.433619 MHz (Color subcarrier frequency)
Fc = 626.953 kHz (Down converted color subcarrier frequency)

Fig. 1-8 Color signal recording system

This is a direct recording system using a down converted phase shifted color signal. The phase shift system removes color crosstalk which cannot be completely eliminated by the azimuth video heads. Fig. 1-8 illustrates a simplified block diagram of this system.

A bandpass filter (BPF) extracts the color component from the input video signal and supplies it to the main converter.

At the same time, the input signal also goes to the horizontal sync separator, which supplies the 15.625 kHz (Fh) to the multiplier and phase shift circuits. Via the phase shifter, the 40 Fh CH-1 track component is supplied directly to the sub converter, but the CH-2 component is delayed in phase 90° every line (1 H). A 25 Hz rectangular wave synchronized to the video head rotation is used for differentiating between the CH-1 and CH-2 components. Each line is also controlled by the Fh input.

The local oscillator produces the color subcarrier frequency 4.433619 MHz (Fs) + 1/8 Fh single frequency which goes to the sub converter. At the sub converter, the 40 Fh and (Fs + 1/8 Fh) are frequency converted to become (Fs + 40 Fh + 1/8 Fh). This is supplied through a highpass filter to the main converter. Also supplied to the main converter are the color signal Fs $^{+0.6}_{-0.8}$ MHz and carrier wave (Fs + 40 Fh + 1/8 Fh). These are down converted to become (40 Fh + 1/8 Fh $^{+0.8}_{-0.6}$ MHz) which through a lowpass filter goes to the mixer for mixing with the FM luminance signal. The result is applied to the video heads.

In other words, the 4.433619 MHz (Fc) color subcarrier is converted to a low band of 626.953 kHz (40 Fh + 1/8 Fh). The down converted color signal is then recorded directly using the FM luminance signal as AC bias.

1.5.1 Color crosstalk correction by phase shift system

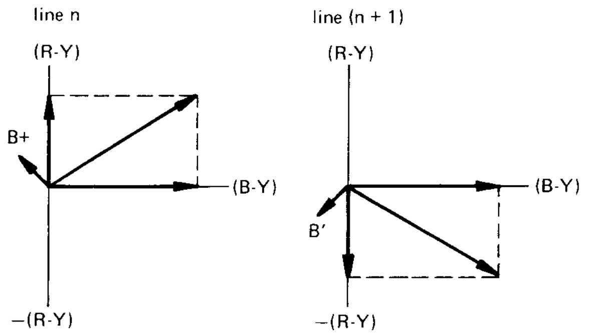

line n
(R-Y)
B+
(B-Y)
−(R-Y)
line (n + 1)
(R-Y)
B′
(B-Y)
−(R-Y)

Fig. 1-9 Vector of color signal

A synchronous quadrature modulation system is employed in which the phase of the color signal R-Y component is reversed every line in order to prevent transmission distortion.

The color signal indicated in Fig. 1-9 is converted to a lowband.
While the CH-1 track component is recorded with phase unchanged, the phase of the CH-2 track component is delayed 90° every line. Fig. 1-10 illustrates the principle of this phase shift system.

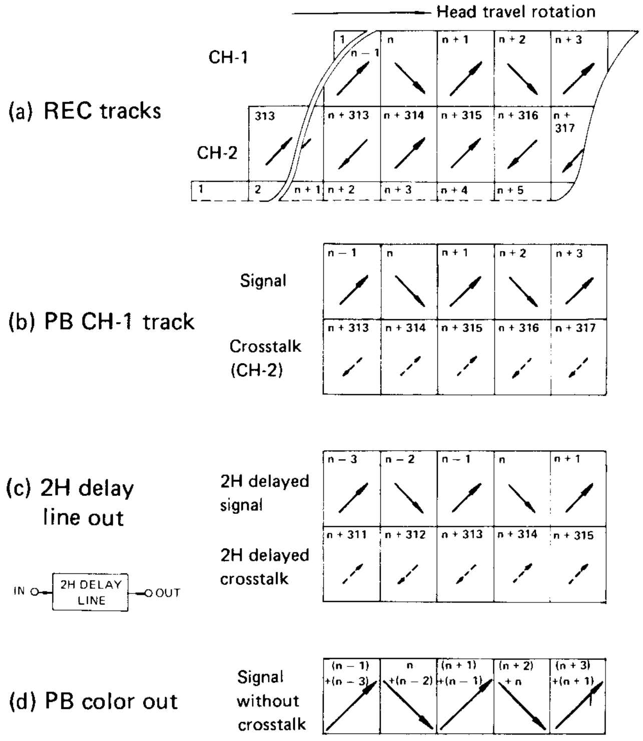

Head travel rotation
(a) REC tracks
CH-1
CH-2
1
n − 1
n
n + 1
n + 2
n + 3
313
n + 313
n + 314
n + 315
n + 316
n + 317
2
n + 1
n + 2
n + 3
n + 4
n + 5
(b) PB CH-1 track
Signal
Crosstalk (CH-2)
(c) 2H delay line out
2H delayed signal
2H delayed crosstalk
n − 3
n − 2
n + 311
n + 312
IN
2H DELAY LINE
OUT
(d) PB color out
Signal without crosstalk
(n − 1) +(n − 3)
n +(n − 2)
(n + 1) +(n − 1)
(n + 2) + n
(n + 3) +(n + 1)

Fig. 1-10 Phase shift system

In the figure, (a) indicates the phase shifted recording pattern. Since the CH-1 head pattern is not phase shifted, the R-Y component phase becomes inverted every line. The phase of the CH-2 head pattern is delayed every line and this causes its R-Y component phase to become inverted every two lines.

During playback, when the CH-1 head picks up a portion of the CH-2 track signal, this becomes the crosstalk component. Phase shift is not required for the main signal from the CH-1 track, and this output is shown by (b). The dotted arrows indicate the crosstalk component and, as can be noted, the phase reverses every 2 lines.

Passing signal (b) through a 2H delay line yields signal (c). In comparing signals (b) and (c), the main signal phase is the same every line, but the crosstalk phase reverses. Therefore, by mixing signals (b) and (c), the crosstalk component of the adjacent track can be removed to result in the playback color signal (d).

In other words, the color signal can be considered in 2 H units. It is recorded by the phase shift system and during playback, the signal through a 2 H delay line is mixed to remove crosstalk.

Crosstalk in the playback color signal (d) effectively becomes zero, while the main signal is enhanced to improve S/N. Also, the CH-2 head playback phase is advanced 90° every line (opposite to recording), producing the same effect. A digital type system is used for phase shifting.

1.5.2 Down converted color subcarrier frequency

The color subcarrier frequency (Fs) can be expressed as:

$$Fs = (n - 1/4)\ Fh + 1/625\ Fh = 283.75\ Fh + 25\ Hz\ (n = 284) = 4.433619\ MHz$$

A line offset system is used in which the subcarrier phase is delayed 90° every line. This avoids serious color noise when the color signal is displayed on a monochrome TV receiver. 25 Hz is added in order to prevent crosscolor.

As indicated in Fig. 1-10, the phase of the color signal R-Y component is inverted every horizontal line to compose a synchronous quadrature modulated signal. Fig. 1-11 shows this color signal spectrum.

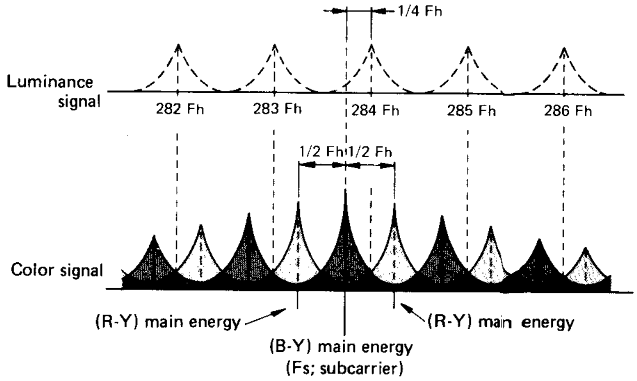

1/4 Fh
Luminance signal
282 Fh
283 Fh
284 Fh
285 Fh
286 Fh
1/2 Fh
1/2 Fh
Color signal
(R-Y) main energy
(R-Y) main energy
(B-Y) main energy
(Fs; subcarrier)

Fig. 1-11 Spectrum of color signal

In the phase shift system, the CH-1 component of the down converted color signal is distributed at 1/2 Fh intervals centered on the Fc (down converted color subcarrier) component. The CH-2 track component is delayed in phase 90° every line, deviated by 1/4 Fh, and distributed at 1/2 Fh intervals centered on Fc. This spectrum is shown in Fig. 1-12.

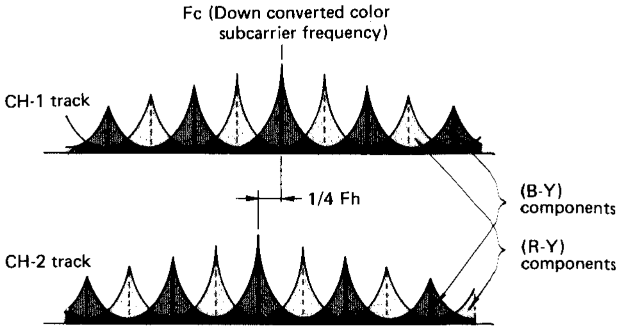

Fc (Down converted color subcarrier frequency)
CH-1 track
1/4 Fh
(B-Y) components
CH-2 track
(R-Y) components

Fig. 1-12 Spectrum of down converted color signal

The FM luminance and down converted color signals are mixed to become the recording current. When recorded and played back using magnetic tape, which prossesses 3-dimensional distortion and nonlinearity, interference in the form of Fo + 2F_{DC} (Fo : FM carrier; F_{DC} : down converted color signal) becomes introduced and cannot be ignored. When the 2F_{DC} component is detected and demodulated, beat becomes produced with respect to the luminance signal and appears in the picture. Therefore, as with the color signal, Fc (down converted color subcarrier frequency) must be selected so that the 2F_{DC} component becomes 1/4 offset in relation to the luminance signal, i.e.:

$$2Fc = \frac{2n-1}{4} Fh$$

$$Fc = \frac{2n-1}{8} Fh = \frac{321}{8} Fh = 40\ Fh + \frac{1}{8} Fh\ (n = 161)$$

$$= 625 + 1.953 = 626.953\ kHz$$

When Fc is determined at (40 Fh + 1/8 Fh), the spectrum of the CH-1 track B-Y component appears at (nFh + 1/8 Fh) and the R-Y component at (nFh – 3/8 Fh). In the CH-2 track distribution, B-Y appears at (nFh – 1/8 Fh) and R-Y at (nFh – 5/8 Fh).

Fig. 1-13 shows the 2F_{DC} component spectrum with respect to the playback luminance signal at this time.

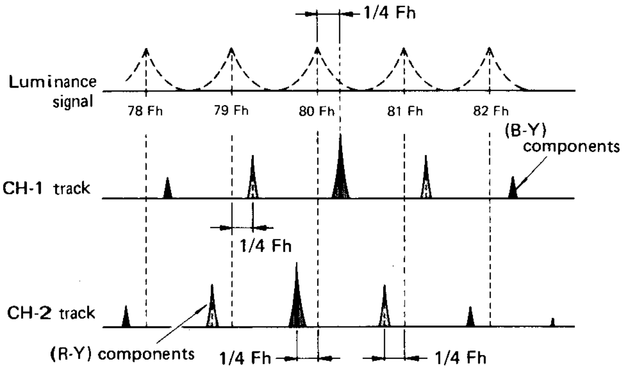


Fig. 1-13 2F_{DC} playback spectrum

The 2F_{DC} components for both CH-1 and CH-2 become 1/4 line offset with respect to the luminance signal and thereby visually reduced. The 626.953 value was selected for both reducing noise and in consideration of color bandwidth.

1.5.3 Color signal recording bandwidth

Response curves for the highpass and lowpass filters are indicated in Fig. 1-14.

Constant current characteristics are possessed by the down converted color signal recording current.

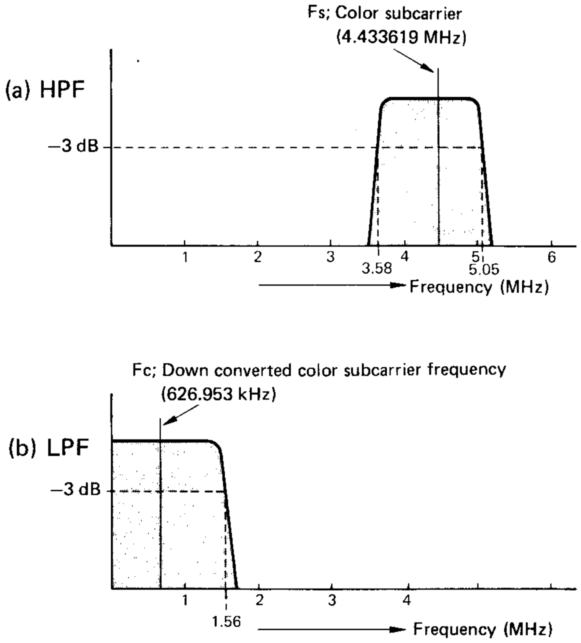


Fig. 1-14 Color signal recording bandwidth

1.6 COLOR SIGNAL PLAYBACK SYSTEM

The color signal playback system performs essentially the opposite function as the recording system. In addition, however, important corrections must be performed for color signal frequency and phase errors introduced by variations in tape speed and head rotation, and elasticity of the tape.

Fig. 1-15 indicates an abbreviated block diagram of this system.

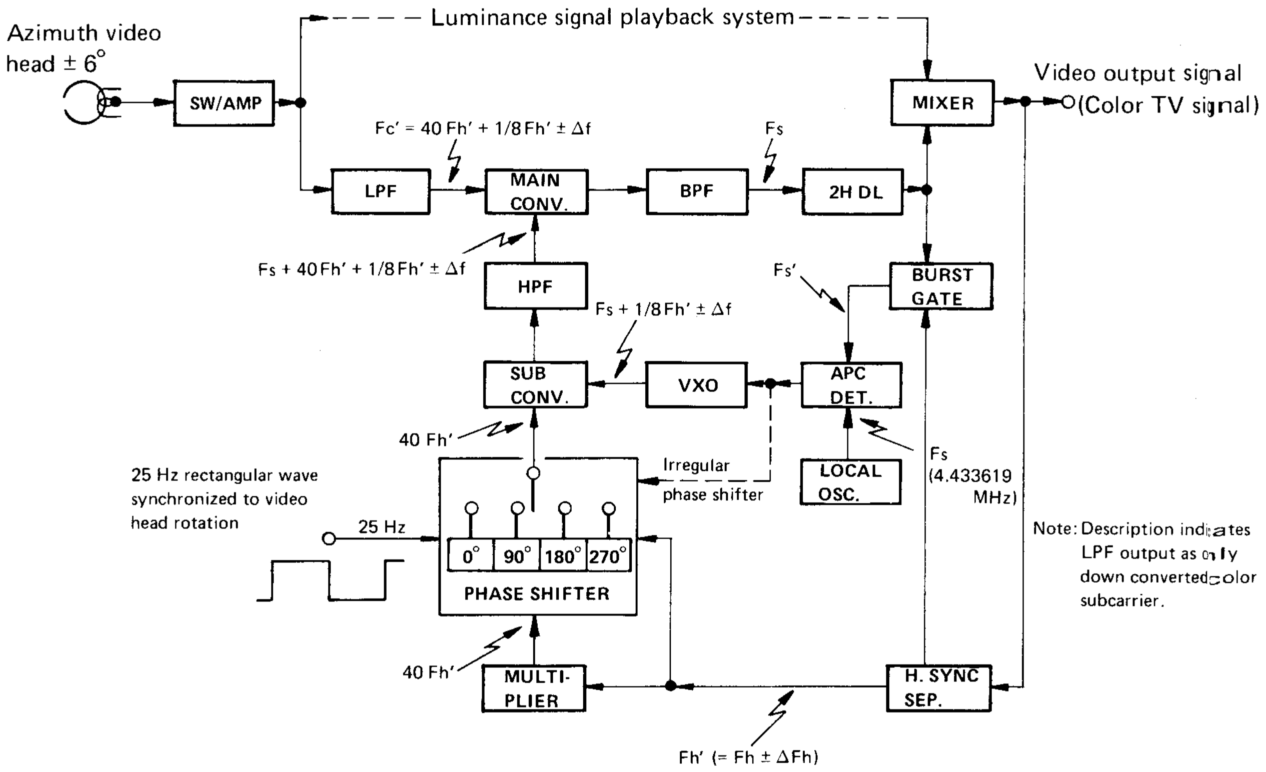
Though a lowpass filter, the down converted color signal goes to the main converter. At this time, the down converted color subcarrier (Fc) contains an error component (40 Fh' + 1/8 Fh' ± Δf) due to mechanical factors of the heads and tape. Fh' varies with the tape speed as Fh ± ΔFh. Δf is the instantaneous error caused by head rotation irregularities and tape elongation and contraction.

The 40 Fh' frequency deviation component is compensated by supplying the video output signal to the horizontal sync separator, multiplier and phase shifter, and 40 Fh' to the sub converter. This forms the AFC (automatic frequency compensator) loop.

In the APC (automatic phase compensator) loop, the 1/8 F'h ± Δf phase error component is compensated by comparing the burst component of the up converted playback color signal with the subcarrier frequency from the local oscillator and APC detector. A variable crystal oscillator (VXO) produces (Fs + 1/8Fh' ± Δf) which goes to the sub converter. As a result, (Fs + 40 Fh' + 1/8 Fh' + Δf) is supplied as the main converter carrier input from the sub converter through a highpass filter.

By frequency conversion with Fc, the color subcarrier frequency of 4.433619 MHz, which is free from frequency and phase deviations, becomes obtained through a bandpass filter. In the opposite manner as with recording, the phase shifter advances the CH-2 track phase 90° every line and 40 Fh' is supplied to the sub converter. The playback color signal through the main converter and bandpass filter is applied to a 2 H delay line for removing crosstalk. Characteristics of the lowpass and bandpass filters are the same as those for recording (Fig. 1-15).

At the mixer, the playback color and luminance signals are mixed to become the video output signal.


Luminance signal playback system
Azimuth video head ± 6°
SW/AMP
MIXER
Video output signal (Color TV signal)
Fc' = 40 Fh' + 1/8Fh' ± Δf
Fs
LPF
MAIN CONV.
BPF
2H DL
Fs + 40Fh' + 1/8Fh' ± Δf
HPF
Fs + 1/8Fh' ± Δf
Fs'
BURST GATE
SUB CONV.
VXO
APC DET.
40 Fh'
Irregular phase shifter
LOCAL OSC.
Fs (4.433619 MHz)
25 Hz rectangular wave synchronized to video head rotation
25 Hz
0°
90°
180°
270°
PHASE SHIFTER
40 Fh'
MULTI-PLIER
H. SYNC SEP.
Fh' (= Fh ± ΔFh)

Note: Description indicates LPF output as only down converted color subcarrier.

Fig. 1-15 Color signal playback system

1.7 CONTROL SIGNAL RECORDING SYSTEM

Control signal waveform, polarity and video head relationships are indicated in Fig. 1-16.

Phase of the control signal is the same as the vertical sync signal rise component of the CH-1 track. The positive pulse voltage is the reference 25 Hz.

The control signal is recorded on the control track above the saturation recording level.

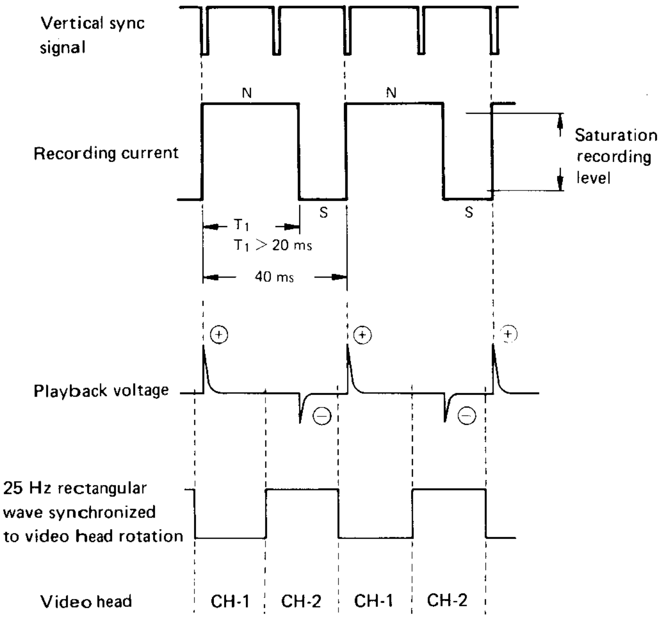

Vertical sync signal
N
N
Recording current
Saturation recording level
S
S
T1
T1 > 20 ms
40 ms
⊕
⊕
⊕
Playback voltage
⊖
⊖
25 Hz rectangular wave synchronized to video head rotation
Video head
CH-1
CH-2
CH-1
CH-2

Fig. 1-16 Control signal

1.8 AUDIO SIGNAL RECORDING SYSTEM

1.8.1 Audio signal recording level

Audio signal is recorded on the audio track to the defined level using an AC bias current recording system.

1.8.2 Audio signal recording current characteristics

The equalizing amplifier controls the recording current in order to obtain a flat frequency characteristic in the reproduced output. See Fig. 1-17.

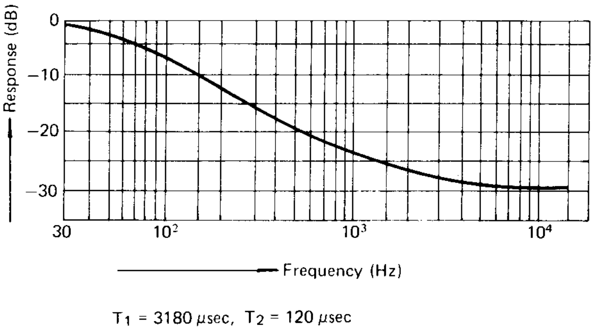


Fig. 1-17 Audio equalizing frequency characteristics

1.9 CASSETTE

1.9.1 Video tape

Length : The relationship between tape length and time for recording and playback can be defined by the formula:

$$L = [1.42t + 2]^{+3}_{0}$$

where, L : tape length (m)
t : recording or playback time (minutes)

Note: L shall be an integer obtained after all decimals produced in calculation are raised. (See "Reference Table".)

Width : 12.65 ± 0.01 mm
Fluctuation : less than 6 μm
Thickness : 19^{+1}_{-2} μm
Coercivity : 600 oersted class (nominal)
Optimum recording current shall not differ from the standard tape.

[Reference Table]

Kinds of blank cassettes

Kind of cassette	Recording or playback time	Length of video tape
E-180	180 min.	258^{+3}_{0} m
E-150	150 min.	215^{+3}_{0} m
E-120	120 min.	173^{+3}_{0} m
E-90	90 min.	130^{+3}_{0} m
E-60	60 min.	88^{+3}_{0} m
E-30	30 min.	45^{+3}_{0} m

1.9.2 Leader tape and Trailer tape

Length : In case time for recording or playback is:
over 90 minutes : 170 ± 20 mm
just or under 90 minutes : 150 ± 20 mm
Width : 12.65 ± 0.03 mm
Thickness : 40^{+5}_{-25} μm
Material : Polyester film
Transparency : more than 50%
Length of splicing: 12 ~ 19 mm
Gap of splicing : 0 ~ 70 μm
Splicing force : more than 3 kg

1.9.3 Reel

Outside diameter : 89 ± 0.2 mm
Hub diameter : In case time for recording or playback is:
over 90 minutes : 26 ± 0.15 mm
just or under 90 minutes : 62 ± 0.2 mm
(If just or under 30 minutes, it can be 70 ± 0.2 mm.)
E-value : more than 1.5 mm

1.9.4 Simplified illustrations

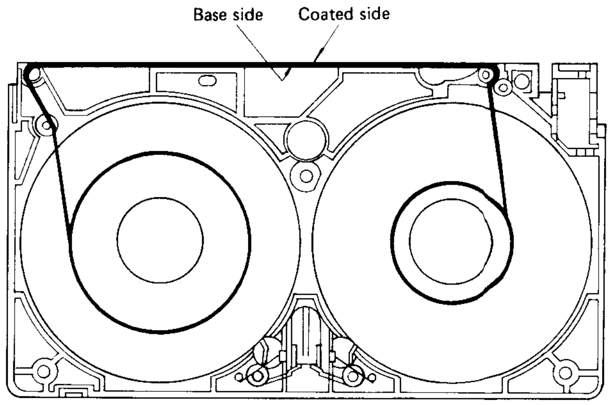

Base side
Coated side

Fig. 1-18 Tape winding and tape path

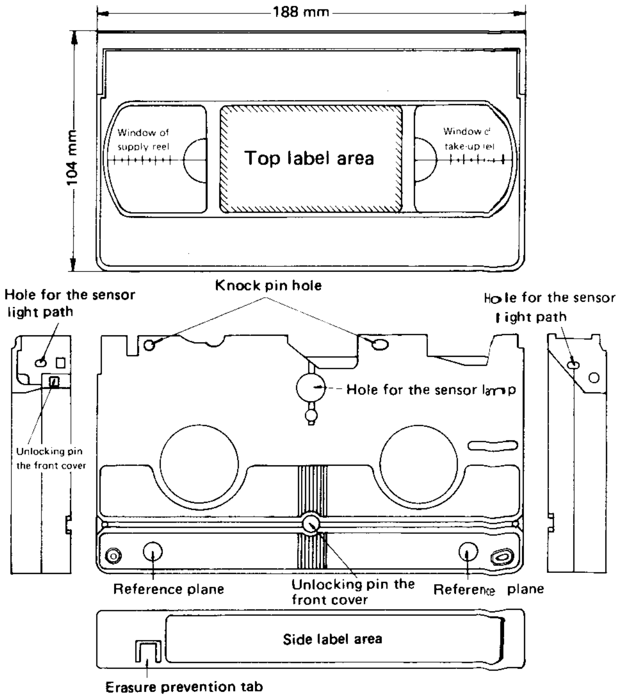

188 mm
104 mm
Window of supply reel
Top label area
Window of take-up reel
Hole for the sensor light path
Knock pin hole
Hole for the sensor light path
Hole for the sensor lamp
Unlocking pin the front cover
Reference plane
Unlocking pin the front cover
Reference plane
Side label area
Erasure prevention tab

Fig. 1-19 Cassette appearance

— MEMO —

[2] SECAM SYSTEM

1.1 GENERAL OUTLINE

The VHS system achieves very low tape consumption and uses low cost video cassette tape. Recording time in the standard mode has become 3 hours.

Increased recording time results from the narrow gap video heads, high sensitivity video tape and the slant azimuth recording head configuration which eliminates the need for a guard band between recorded tracks.
In addition, the VHS format takes into consideration special operating modes such as still picture, slow motion and speed playback. The design also allows switching over between the PAL and NTSC television standards.

Adoption of the VHS format presented several technical challenges. Foremost among these were obtaining high picture quality and high resolution despite the slow (4.9 meters per second) relative speed between the tape and video heads, improving signal to noise ratio (S/N), and preventing black to white reversal phenomena due to the short recording wavelength of 1.0 μm. Also the $\pm 6^\circ$ azimuth angle of the video heads alone is not sufficient to eliminate crosstalk from the lowband converted color FM signal.

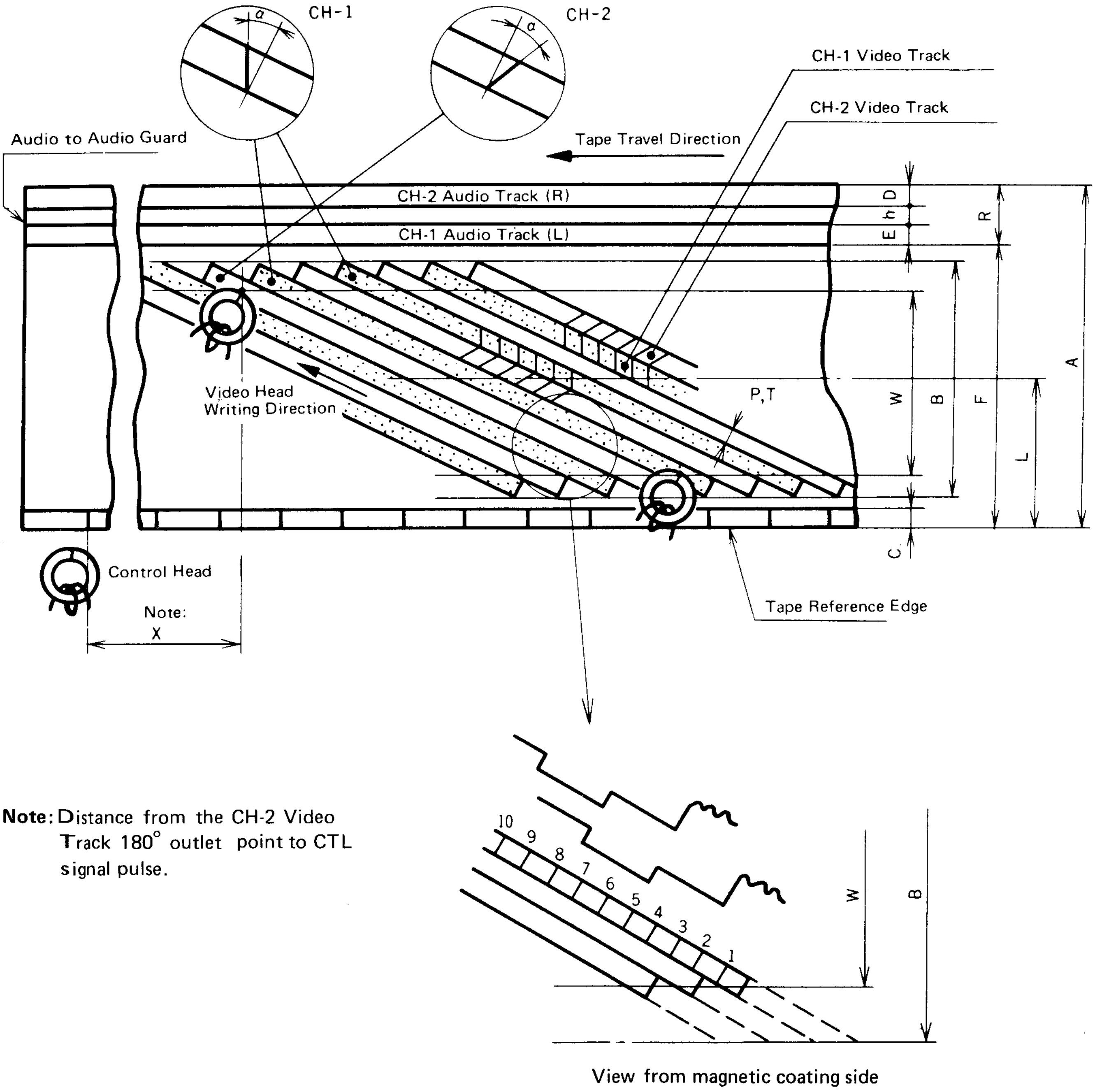
Steps for solving these difficulties included adoption of a nonlinear emphasis circuit and selecting the emphasis amount for optimum S/N. The reversal problem was overcome by using a double limiter circuit, while a 1/4 frequency count down system and a line correlation for the tape pattern have been designed for eliminating color crosstalk.

The following discussion covers several main points of the VHS format.

1.2 MAGNETIC TAPE PATTERN

1.2.1 Standard

In the VHS format, two rotating video heads at ±6° azimuth angle are used for recording without a guard band. Fig. 1-20 indicates the recording pattern, while the pertinent values are listed in Table 1-2.


CH-1
α
CH-2
α
CH-1 Video Track
CH-2 Video Track
Audio to Audio Guard
Tape Travel Direction
CH-2 Audio Track (R)
CH-1 Audio Track (L)
D
h
E
R
A
W
B
F
L
P,T
Video Head
Writing Direction
C
Control Head
Note:
X
Tape Reference Edge
10
9
8
7
6
5
4
3
2
1
W
B
View from magnetic coating side

Note: Distance from the CH-2 Video Track 180° outlet point to CTL signal pulse.

Fig. 1-20 Magnetic tape pattern

Items				Standard	Remarks
1.	(A)	Tape Width	mm	12.65 ± 0.01	
2.	(Vt)	Tape Speed	mm/sec	23.39 ± 0.5%	
3.	(ϕ)	Drum Diameter	mm	62 ± 0.01	(Upper Drum)
4.	(Vh)	Writing Speed	m/sec	4.85	
5.	(P)	Video Track Pitch	mm	0.049	
6.	(B)	Video Width	mm	10.60	
7.	(W)	Video Effective Width	mm	10.07	
8.	(L)	Video Track Center	mm	6.2	Measured from reference edge
9.	(V)	Video Track Width	mm	0.049	
10.	(C)	Control Track Width	mm	0.75	
11.	(R)	Audio Track Width	mm	1.0	Single track
12.	(D)	Audio Track Width	mm	0.35	CH-2 (R)
13.	(E)	Audio Track Width	mm	0.35	CH-1 (L)
14.	(F)	Audio Track Reference Line	mm	11.65	Measured from reference edge
15.	(h)	Audio to Audio Guard Width	mm	0.3	
16.	(θ_o)	Video Track Angle		5° 56′ 7.4″	(Stopped)
17.	(θ)	Video Track Angle		5° 57′ 50.3″	(Running)
18.	(α)	Video Head Gap Azimuth Angle		6° ± 10′	
19.	(X)	Positions of Audio and Control Head	mm	79.244	
20.	( )	Positions of Front Edge of V-SYNC		5 ~ 8H	Inside the W bottom edge
21.	( )	Tape Back-Tension		30 ~ 45 g	At tape beginning and at the drum entrance

Table 1-2 Magnetic tape pattern

Note: Tests and measurements shall be made under the following conditions.
Temperature: 20°C ± 2°C, Relative humidity: 65% ± 5%
However, unless essential to the judgement, these can also be done under the following conditions.
Temperature: 5 ~ 35°C, Relative humidity: 40 ~ 80%

1.2.2 Horizontal correlation

The azimuth head configuration removes crosstalk from most of the high frequency portion of the FM luminance signal, however, it is not able to fully eliminate crosstalk from the low frequency component of the lower side-band portion. This residual crosstalk is reduced by employing line correlation for the tape pattern.

Line correlation (or "H correlation") consists of arranging the horizontal sync signal positions of adjacent recorded tracks. Since this makes the frequencies of the main signal and crosstalk signal very close, the demodulated crosstalk amount becomes extremely low with respect to the main signal. The type of H correlation used in the VHS format is shown in Fig. 1-21.

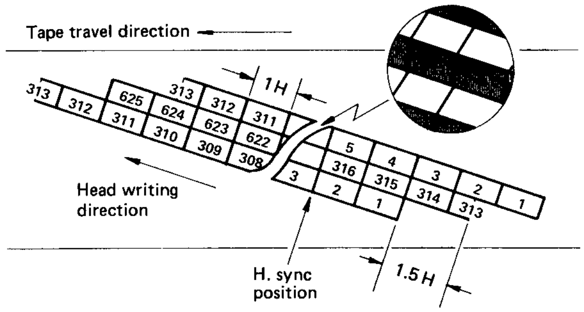


Fig. 1-21 VHS recording signal pattern

In order to provide H correlation in the tape pattern, tape speed, head drum diameter and other factors must be decided. The adjacent track correlation in the VHS format is 1.5 H. This 1.5 H difference is important not only for removing low frequency crosstalk from the luminance signal, but also for correcting color or FM signal crosstalk in the SECAM system.

Another advantage of H correlation is in avoiding skew distortion effects during special operating modes such as still, slow motion, 2x speed and shuttle search, when each video head traces two or more tracks. In these modes, the horizontal sync signals become played back at fixed intervals.

1.3 LUMINANCE SIGNAL RECORDING SYSTEM

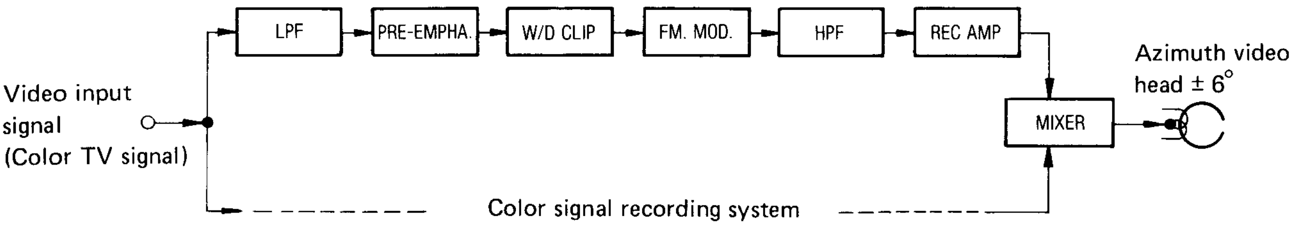


Fig. 1-22 Luminance signal recording system

Frequency modulation (FM) is used for the luminance signal recording system. A simplified block diagram of the system is shown in Fig. 1-22.

A lowpass filter (LPF) removes the color component and passes only the luminance component of the input color TV signal. At the next stage pre-emphasis circuit, the high frequency portion of the luminance signal is enhanced in order to improve S/N during FM recording. Since excess pre-emphasis could lead to black/white reversal due to the shortened recording wavelength, a white/dark clip circuit cuts the overshoot and undershoot components which exceed certain positive and negative levels.

The frequency modulator (FM MOD) converts the AM luminance signal to FM, which goes through a highpass filter (HPF) to the recording amplifier. These circuits amplify the signal with the proper frequency characteristic, after which it is mixed with the down converted color signal and supplied to the video heads.

1.3.1 Luminance signal recording frequency characteristic (LPF)

As shown in Fig. 1-23, when the video input is a color TV signal, a lowpass filter removes the color component and the luminance signal, with a bandwidth of from about 30 Hz to 3.0 MHz, is used. With some VHS models, when the input is a black and white TV signal, it bypasses the LPF, allowing a wider bandwidth to beyond 4 MHz.

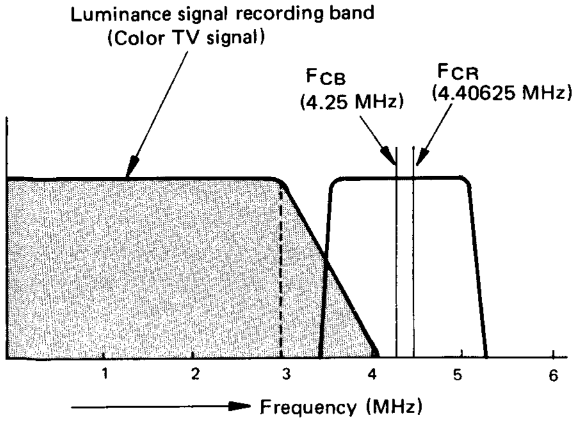
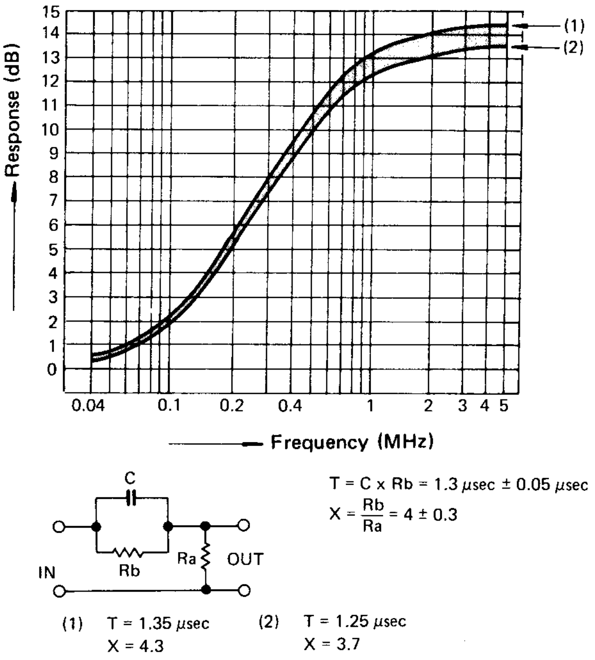


Fig. 1-23 Luminance signal recording band

1.3.2 Pre-emphasis characteristics



$T = C \times Rb = 1.3\,\mu\text{sec} \pm 0.05\,\mu\text{sec}$

$X = \frac{Rb}{Ra} = 4 \pm 0.3$

(1) $T = 1.35\,\mu\text{sec}$, $X = 4.3$

(2) $T = 1.25\,\mu\text{sec}$, $X = 3.7$

Fig. 1-24 Pre-emphasis characteristics

1.3.3 White and dark clip level (See Fig. 1-25.)

White clip level : 160^{+10}_{-50}% measured from sync tip

Dark clip level : 40 ± 10% measured from sync tip

Note: The level from sync tip to white peak is 100%.

1.3.4 FM carrier frequency and deviation (See Fig. 1-25.)

Sync tip : 3.8 ± 0.1 MHz
White peak : 4.8 ± 0.1 MHz
Deviation : 1.0 ± 0.1 MHz

1.3.5 FM signal recording frequency (HPF)

As indicated in Fig. 1-25, when the video input is a color TV signal, it goes through an HPF for vacating the area for the down converted color signal. With some VHS models, when the input is a B/W TV signal, the HPF can be bypassed to extend the bandwidth to the DC area.

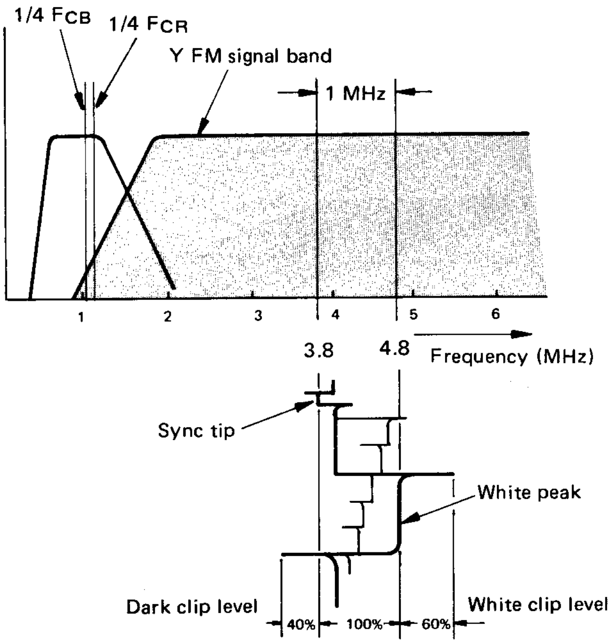


Fig. 1-25 Recording spectrum

1.3.6 FM signal recording amp. characteristics (REC AMP)

Current:
More than 3.8 MHz: Optimum saturation recording current
2 MHz : 3 ± 1 dB
1 MHz : 6 ± 1 dB
Less than 1 MHz : Flat characteristics

Note: 0 dB at 3.8 MHz

1.3.7 FM signal head current (VIDEO HEAD)

It shall be within ±1.5 dB of 4 MHz optimum recording current.

1.4 LUMINANCE SIGNAL PLAYBACK SYSTEM

This system functions to return the signals recorded on the tape to a form as close as possible to the video input signals. The simplified block diagram is shown in Fig. 1-26.

The low level FM signals played back by the two video heads are combined into a single FM signal by the switching amplifier. After amplification to the required frequency characteristic, a highpass filter attenuates the down converted color signal and passes only the FM luminance signal. This HPF has the same response as that of the recording system.

Variations in the playback FM signal level due to mechanical stretching and contraction of the tape, and irregularities in tape to head contact, are corrected by the limiter circuit. The signal is amplified more than 80 dB to permit precise demodulation. A double limiter circuit is employed in order to prevent black/white reversal effects.

In the following stages, the demodulator and lowpass filter return the luminance signal to its AM form. The de-emphasis circuit reverses the emphasis applied during recording. From this point, the signal goes to the mixer where it is mixed with the playback color signal to become the video output siganl.

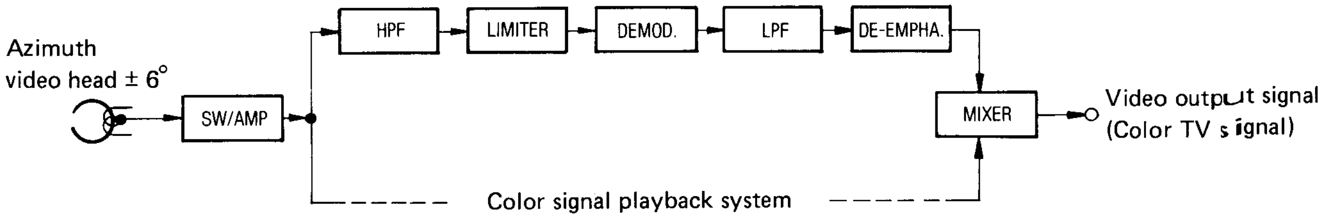

Azimuth video head ± 6°
SW/AMP
HPF
LIMITER
DEMOD.
LPF
DE-EMPHA.
MIXER
Video output signal (Color TV signal)
Color signal playback system

Fig. 1-26 Luminance signal playback system

1.5 COLOR SIGNAL RECORDING SYSTEM

1.5.1 SECAM color television signal

The SECAM color signal is frequency modulated in order to avoid color hue fluctuations due to phase distortion in the transmitting system. Alternating lines are used for the modulated R-Y and B-Y signals. Two subcarrier frequencies are employed: 282 Fh = 4.40625 MHz (Fh = 15.625 kHz) for the R-Y component and 272 Fh = 4.25000 MHz for the B-Y component, which reduce the visible appearance of dot interference between the scanning lines.

To provide compatibility with B/W television, the signal goes through an anti-bell filter with a center frequency of 4.286 MHz. This attenuates the unmodulated carrier component, after which the signal is mixed with luminance.

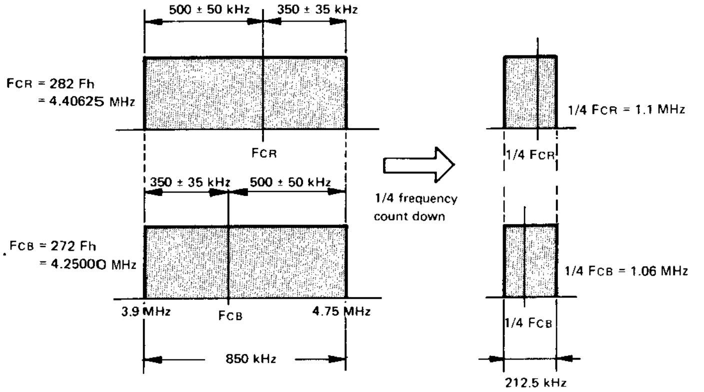
Since pre-emphasis is applied prior to modulation, the frequency deviation range of the color FM carrier becomes 850 kHz between 3.9 MHz and 4.75 MHz. When the sidebands are included, the resulting range exceeds 2 MHz.

Because of the wider color signal bandwidth of SECAM, the down converted phase shift system used for PAL and NTSC cannot be applied effectively due to the difference in azimuth effect between the high and low frequency components of the down converted color signal.

The line sequential FM signal also does not include phase correlation between lines, which makes crosstalk removal by the rotation method difficult. As a result of these factors, a 1/4 countdown direct recording system is used for SECAM.

1.5.2 1/4 frequency countdown recording

1. Color FM carrier bandwidth



(a) Color FM carrier bandwidth (b) 1/4 frequency counted down color FM carrier bandwidth

Fig. 1-27 Color FM carrier bandwidth

Fig. 1-27 (a) indicates the FM carrier bandwidth of the color signal, while (b) shows the counted down bandwidth. By counting down the frequency 1/4th, the recording bandwidth becomes 1/4th and azimuth loss difference between high and low frequency components can be reduced.

2. Color signal horizontal correlation

The color FM signal pattern based on the horizontal correlation of section 1.2.2 is shown in Fig. 1-28.

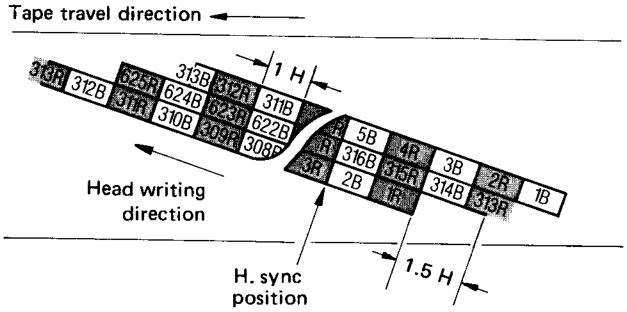


Fig. 1-28 Recording color signal pattern

As indicated, the pattern is distributed with a 1.5 H difference between adjacent tracks. The horizontal sync signals of adjacent tracks are arranged, while the R-Y and B-Y components become distributed between the adjacent track sync periods.

Consequently, in the same manner as the luminance signal, the color FM signal also possesses line and field correlations. The angular frequency difference between the playback main and crosstalk signals becomes nearly zero, while the demodulated crosstalk amount is very small compared to the main signal.

In this manner, the SECAM signal can be recorded in the VHS type format without using a guardband and without a crosstalk preventing circuit.

3. Modulation index

The color signal FM carrier covers the 850 kHz frequency range from 3.9 to 4.75 MHz, and when the FM waveform sidebands are included, the occupied range becomes more than 2 MHz. Since the sidebands remain unchanged even after 1/4th frequency countdown, they continue to cover the 2 MHz range centered on 1/4 FCR and 1/4 FCB.

However, after frequency countdown, the modulation index becomes 1/4th. Therefore, the sideband level is reduced about 10 dB with respect to the carrier component, which increases the margin for avoiding color reversal effects.

With a 1/4th modulation index, the required bandwidth for the color signal can be reduced to about 1/4th, thereby reducing the recording bandwidth by several hundred kHz. As a result, both sidebands of the color FM signal are recorded, reducing the likelihood of color reversal.

1.5.3 Recording block diagram

A simplified block diagram of the 1/4 frequency countdown direct recording system is shown in Fig. 1-29.

Bandpass filter BPF-1 separates the color component from the input video signal. The bell block functions to return the signal from the anti-bell characteristic used during transmission to a flat waveform which is easily counted down. The signal then goes through a limiter to the 1/4 frequency countdown circuit.

This circuit converts the color FM carrier from the 3.9 to 4.75 MHz range to the 0.98 to 1.19 MHz range. The next stage BPF-2 then limits the upper range of the frequency prior to mixing with the FM luminance signal.

In consideration of S/N and color reversal, the lower sideband is limited, after which the signal goes to the lowband anti-bell block. This circuit imparts an anti-bell characteristic to the counted down FM carrier. The unmodulated carrier component is attenuated and S/N improved.

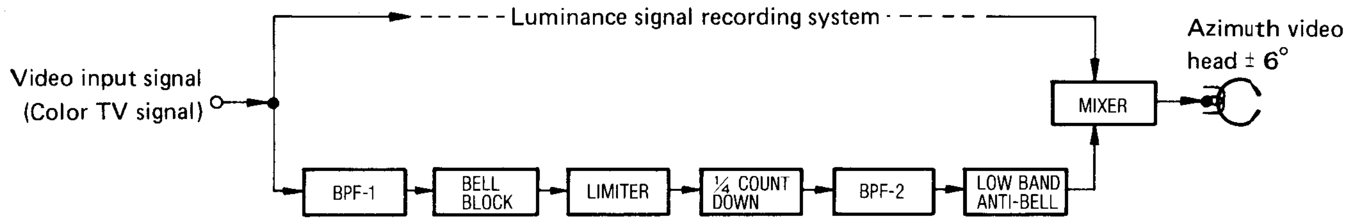


Fig. 1-29 Color signal recording system

1.5.4 Recording bandwidth

Fig. 1-30 illustrates the response curves of BPF-1 and BPF-2.

A constant current characteristic is used for recording the counted down color signal.

The generalized characteristics of the bell and lowband anti-bell blocks for recording are shown in Fig. 1-31.

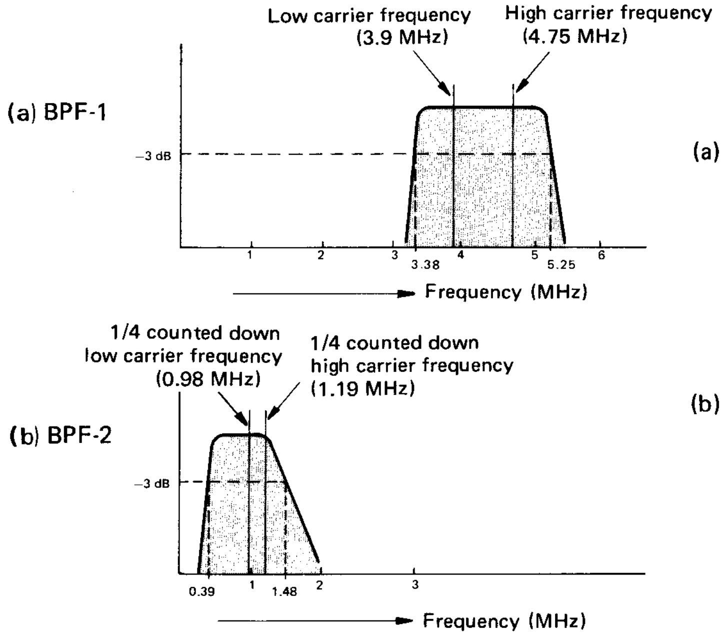


Fig. 1-30 Color signal recording bandwidth

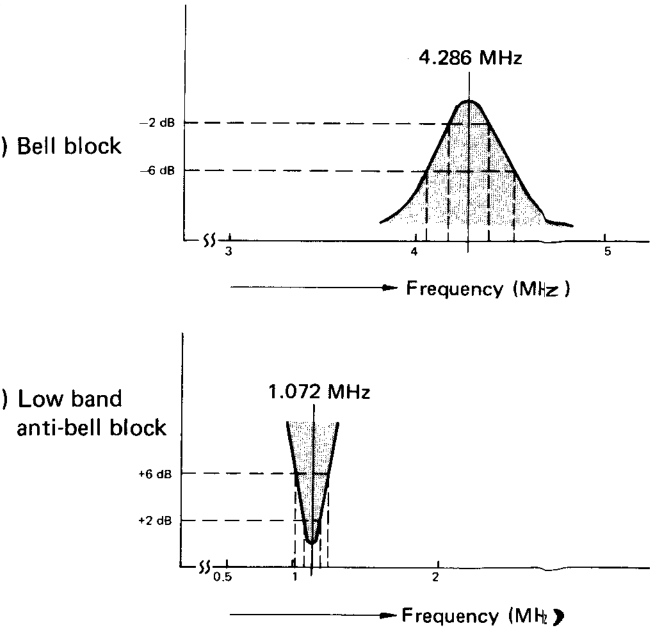


Fig. 1-31 Recording bell block characteristics

1.6 COLOR SIGNAL PLAYBACK SYSTEM

This system functions in the opposite manner as the recording system. In the case of NTSC and PAL, compensating loop circuits are needed to correct for frequency and phase variations in the playback color signal due to fluctuations in tape speed, head rotation and tape elasticity, which can cause color shifts or loss of color in the TV receiver display. However, since the SECAM signal is FM, frequency and phase deviations do not pose a problem. The compensating circuits are therefore not needed. The simplified block diagram is shown in Fig 1-32.

The lowband color FM signal is obtained by applying the playback signal to a lowpass filter. After shaping by the lowband bell block, the 4 times countup circuit returns the wide bandwidth of the color FM signal.

A bandpass filter yields the specified color signal bandwidth, after which the anti-bell block attenuates the unmodulated carrier component. The signal is then mixed with luminance to produce the video output signal.

Characteristics of the bandpass filter are the same as those of BPF-1 indicated in Fig. 1-30, while the bell block characteristics are opposite of those shown in Fig. 1-31.

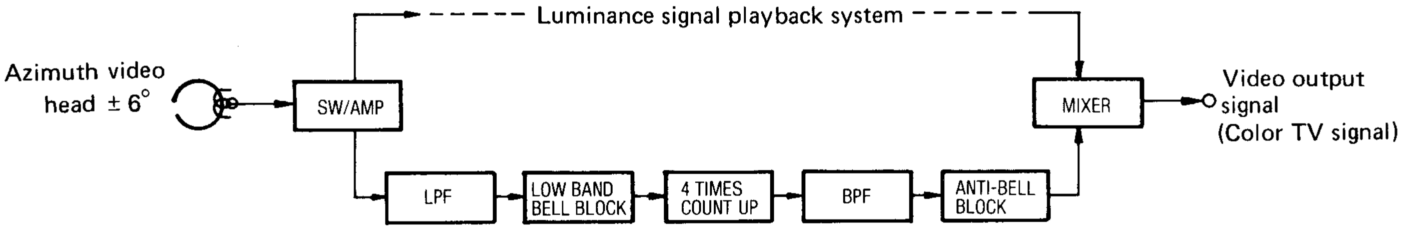

Luminance signal playback system
Azimuth video head ± 6°
SW/AMP
MIXER
Video output signal (Color TV signal)
LPF
LOW BAND BELL BLOCK
4 TIMES COUNT UP
BPF
ANTI-BELL BLOCK

Fig. 1-32 Color signal playback system

1.7 CONTROL SIGNAL RECORDING SYSTEM

Control signal waveform, polarity and video head relationships are indicated in Fig. 1-33.

Phase of the control signal is the same as the vertical sync signal rise component of the CH-1 track. The positive pulse voltage is the reference 25 Hz.

The control signal is recorded on the control track above the saturation recording level.

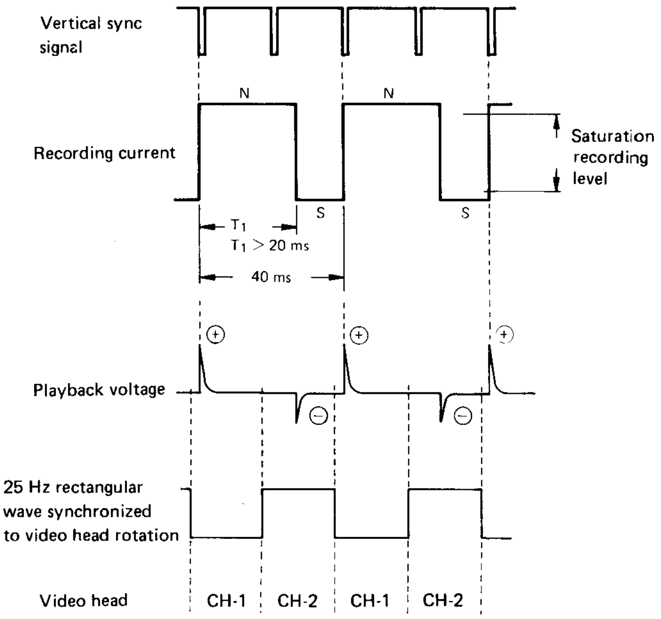

Vertical sync signal
N
N
Recording current
Saturation recording level
T1
S
S
T1 > 20 ms
40 ms
⊕
⊕
⊕
Playback voltage
⊖
⊖
25 Hz rectangular wave synchronized to video head rotation
Video head
CH-1
CH-2
CH-1
CH-2

Fig. 1-33 Control signal

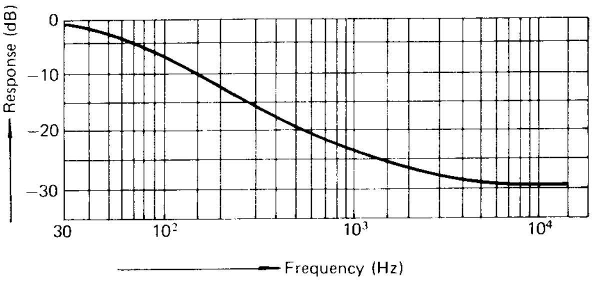
1.8 AUDIO SIGNAL RECORDING SYSTEM

1.8.1 Audio signal recording level

Audio signal is recorded on the audio track to the defined level using an AC bias current recording system.

1.8.2 Audio signal recording current characteristics

The equalizing amplifier controls the recording current in order to obtain a flat frequency characteristic in the reproduced output. See Fig. 1-34.



T_1 = 3180 µsec, T_2 = 120 µsec

Fig. 1-34 Audio equalizing frequency characteristics

1.9 CASSETTE

1.9.1 Video tape

Length : The relationship between tape length and time for recording and playback can be defined by the formula:

$$L = [1.42t + 2]^{+3}_{0}$$

where, L : tape length (m)
t : recording or playback time (minutes)

Note: L shall be an integer obtained after all decimals produced in calculation are raised. (See "Reference Table".)

Width : 12.65 ± 0.01 mm
Fluctuation : less than 6 µm
Thickness : 19^{+1}_{-2} µm
Coercivity : 600 oersted class (nominal)
Optimum recording current shall not differ from the standard tape.

[Reference Table]

Kinds of blank cassettes

Kind of cassette	Recording or playback time	Length of video tape
E-180	180 min.	258^{+3}_{0} m
E-150	150 min.	215^{+3}_{0} m
E-120	120 min.	173^{+3}_{0} m
E-90	90 min.	130^{+3}_{0} m
E-60	60 min.	88^{+3}_{0} m
E-30	30 min.	45^{+3}_{0} m

1.9.2 Leader tape and Trailer tape

Length : In case time for recording or playback is:
over 90 minutes : 170 ± 20 mm
just or under 90 minutes : 150 ± 20 mm
Width : 12.65 ± 0.03 mm
Thickness : 40^{+5}_{-25} µm
Material : Polyester film
Transparency : more than 50%
Length of splicing: 12 ~ 19 mm
Gap of splicing : 0 ~ 70 µm
Splicing force : more than 3 kg

1.9.3 Reel

Outside diameter : 89 ± 0.2 mm
Hub diameter : In case time for recording or playback is:
over 90 minutes : 26 ± 0.15 mm
just or under 90 minutes : 62 ± 0.2 mm
(If just or under 30 minutes, it can be 70 ± 0.2 mm.)
E-value : more than 1.5 mm

1.9.4 Simplified illustrations

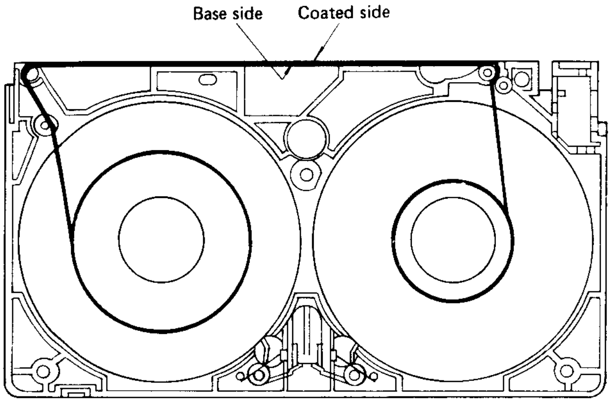

Base side
Coated side

Fig. 1-35 Tape winding and tape path

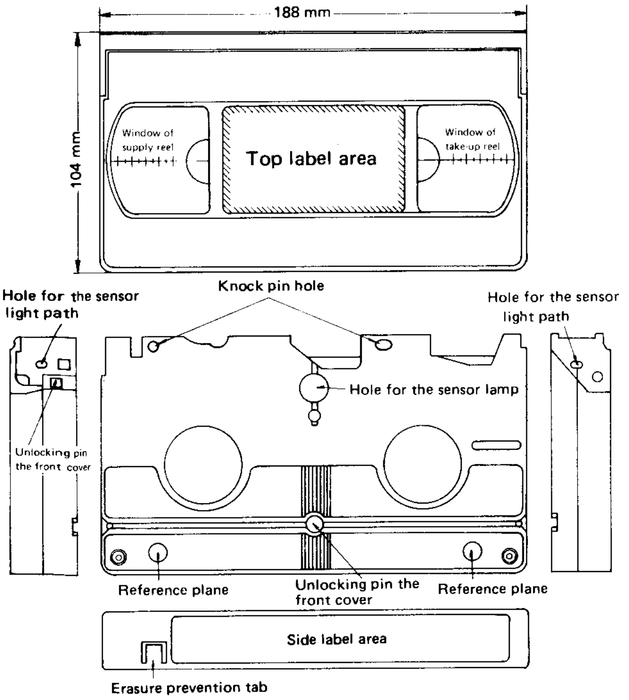

188 mm
104 mm
Window of supply reel
Top label area
Window of take-up reel
Hole for the sensor light path
Knock pin hole
Hole for the sensor light path
Hole for the sensor lamp
Unlocking pin the front cover
Reference plane
Unlocking pin the front cover
Reference plane
Side label area
Erasure prevention tab

Fig. 1-36 Cassette appearance

[3] NTSC SYSTEM

1.1 GENERAL OUTLINE

The VHS system achieves very low tape consumption and uses low cost video cassette tape. Recording time in the standard mode has become 2 hours.

Increased recording time results from the narrow gap video heads, high sensitivity video tape and the slant azimuth recording head configuration which eliminates the need for a guard band between recorded tracks.
In addition, the VHS format takes into consideration special operating modes such as still picture, slow motion and speed playback.

Adoption of the VHS format presented several technical challenges. Foremost among these were obtaining high picture quality and high resolution despite the slow (5.9 meters per second) relative speed between the tape and video heads, improving signal to noise ratio (S/N), and preventing black to white reversal phenomena due to the short recording wavelength of 1.2 μm. Also the $\pm 6^\circ$ azimuth angle of the video heads alone is not sufficient to eliminate crosstalk from the lowband converted color signal.

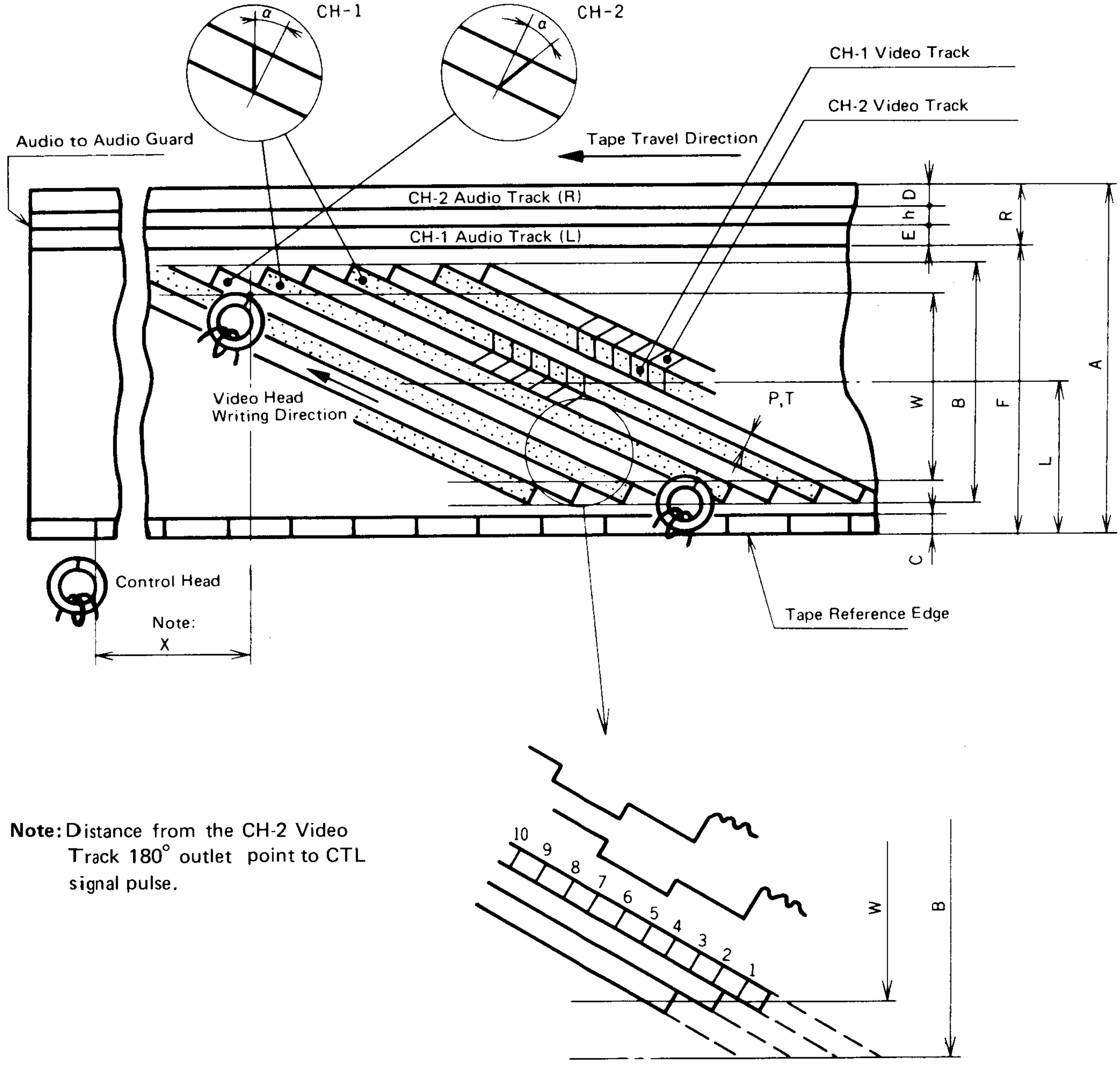
Steps for solving these difficulties included adoption of a nonlinear emphasis circuit and selecting the emphasis amount for optimum S/N. The reversal problem was overcome by using a double limiter circuit, while a phase shift system has been designed for eliminating color crosstalk.

The following discussion covers several main points of the VHS format.

1.2 MAGNETIC TAPE PATTERN

1.2.1 Standard

In the VHS format, two rotating video heads at ±6° azimuth angle are used for recording without a guard band. Fig. 1-37 indicates the recording pattern, while the pertinent values are listed in Table 1-3.


CH-1
α
CH-2
α
CH-1 Video Track
CH-2 Video Track
Audio to Audio Guard
Tape Travel Direction
CH-2 Audio Track (R)
CH-1 Audio Track (L)
D
h
E
R
A
W
B
F
L
P,T
Video Head Writing Direction
Control Head
Note:
X
C
Tape Reference Edge
10
9
8
7
6
5
4
3
2
1
W
B

Note: Distance from the CH-2 Video Track 180° outlet point to CTL signal pulse.

View from magnetic coating side

Fig. 1-37 Magnetic tape pattern

Items		Standard	Remarks
1. (A) Tape Width	mm	12.65 ± 0.01	
2. (Vt) Tape Speed	mm/sec	33.35 ± 0.5%	
3. (ϕ) Drum Diameter	mm	62 ± 0.01	(Upper Drum)
4. (Vh) Writing Speed	m/sec	5.80	
5. (P) Video Track Pitch	mm	0.058	
6. (B) Total Video Width	mm	10.60	
7. (W) Video Effective Width	mm	10.07	
8. (L) Video Track Center	mm	6.2	Measured from reference edge
9. (T) Video Track Width	mm	0.058	
10. (C) Control Track Width	mm	0.75	
11. (R) Audio Track Width	mm	1.0	Single track
12. (D) Audio Track Width	mm	0.35	CH-2 (R)
13. (E) Audio Track Width	mm	0.35	CH-1 (L)
14. (F) Audio Track Reference Line	mm	11.65	Measured from reference edge
15. (h) Audio to Audio Guard Width	mm	0.3	
16. (θ_0) Video Track Angle		5°56′ 7.4″	(Stopped)
17. (θ) Video Track Angle		5°58′ 9.9″	(Running)
18. (α) Video Head Gap Azimuth Angle		6° ± 10′	
19. (X) Positions of Audio and Control Heads	mm	79.244	
20. ( ) Positions of Front Edge of V-SYNC		5 ~ 8H	Inside the W bottom edge
21. ( ) Tape Back-Tension		30 ~ 45 g	At the tape beginning and the drum entrance

Table 1-3 Magnetic tape pattern

Note: Tests and measurements shall be made under the following conditions.
Temperature: 20°C ± 2°C, Relative humidity: 65% ± 5%
However, unless essential to the judgement, these can also be done under the following conditions.
Temperature: 5 ~ 35°C, Relative humidity: 40 ~ 80%

1.2.2 Horizontal correlation

The azimuth head configuration removes crosstalk from most of the high frequency portion of the FM luminance signal, however, it is not able to fully eliminate crosstalk from the low frequency component of the lower sideband portion. This residual crosstalk is reduced by employing line correlation for the tape pattern.

Line correlation (or "H correlation") consists of arranging the horizontal sync signal positions of adjacent recorded tracks. Since this makes the frequencies of the main signal and crosstalk signal very close, the demodulated crosstalk amount becomes extremely low with respect to the main signal. The type of H correlation used in the VHS format is shown in Fig. 1-38.

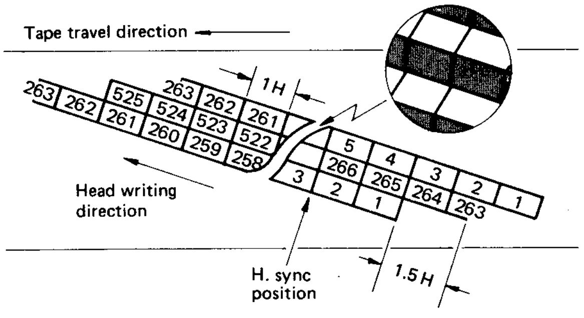


Fig. 1-38 VHS recording signal pattern

In order to provide H correlation in the tape pattern, tape speed, head drum diameter and other factors must be decided. The adjacent track correlation in the VHS format is 1.5 H. This 1.5 H difference is important for removing low frequency crosstalk from the luminance signal.

Another advantage of H correlation is in avoiding skew distortion effects during special operating modes such as still, slow motion, 2x speed and shuttle search, when each video head traces two or more tracks. In these modes, the horizontal sync signals become played back at fixed intervals.

Note: The recording pattern of 6-hour extended mode satisfies the horizontal correlation.

1.3 LUMINANCE SIGNAL RECORDING SYSTEM

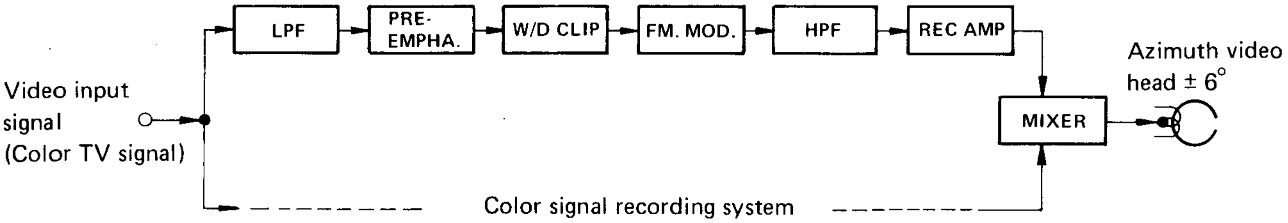


Fig. 1-39 Luminance signal recording system

Frequency modulation (FM) is used for the luminance signal recording system. A simplified block diagram of the system is shown in Fig. 1-39.

A lowpass filter (LPF) removes the color component and passes only the luminance component of the input color TV signal. At the next stage pre-emphasis circuit, the high frequency portion of the luminance signal is enhanced in order to improve S/N during FM recording. Since excess pre-emphasis could lead to black/white reversal due to the shortened recording wavelength, a white/dark clip circuit cuts the overshoot and undershoot components which exceed certain positive and negative levels.

The frequency modulator (FM MOD) converts the AM luminance signal to FM, which goes through a highpass filter (HPF) to the recording amplifier. These circuits amplify the signal with the proper frequency characteristic, after which it is mixed with the down converted color signal and supplied to the video heads.

1.3.1 Luminance signal recording frequency characteristic (LPF)

As shown in Fig. 1-40, when the video input is a color TV signal, a lowpass filter removes the color component and the luminance signal, with a bandwidth of from about 30 Hz to 3.0 MHz, is used. With some VHS models, when the input is a black and white TV signal, it bypasses the LPF, allowing a wider bandwidth to beyond 4.2 MHz.

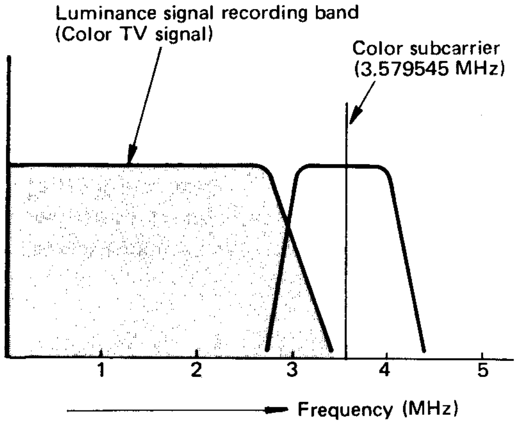


Fig. 1-40 Luminance signal recording band

1.3.2 Pre-emphasis characteristics

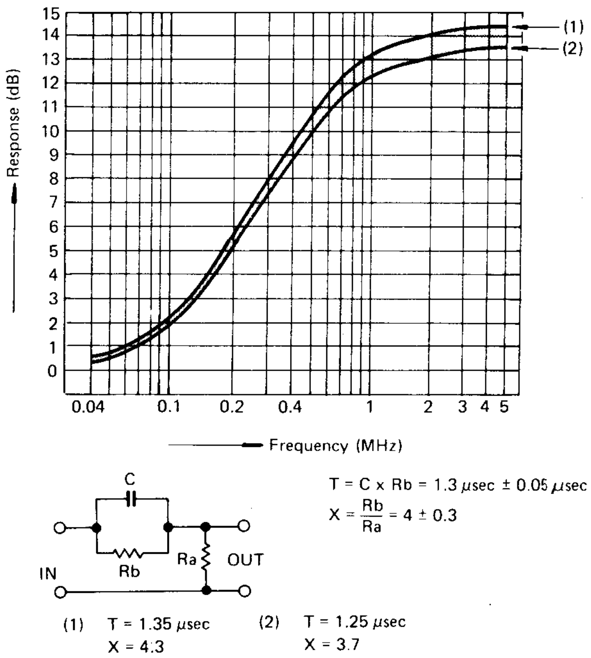


Fig. 1-41 Pre-emphasis characteristics

1.3.3 White and dark clip level (See Fig. 1-42.)

White clip level : 160^{+10}_{-5}% measured from sync tip

Dark clip level : 40 ± 10% measured from sync tip

Note: The level from sync tip to white peak is 100%.

1.3.4 FM carrier frequency and deviation (See Fig. 1-42.)

Sync tip : 3.4 ± 0.1 MHz
White peak : 4.4 ± 0.1 MHz
Deviation : 1.0 ± 0.1 MHz

1.3.5 FM signal recording frequency (HPF)

As indicated in Fig. 1-42, when the video input is a color TV signal, it goes through an HPF for vacating the area for the down converted color signal. With some VHS models, when the input is a B/W TV signal, the HPF can be bypassed to extend the bandwidth to the DC area.

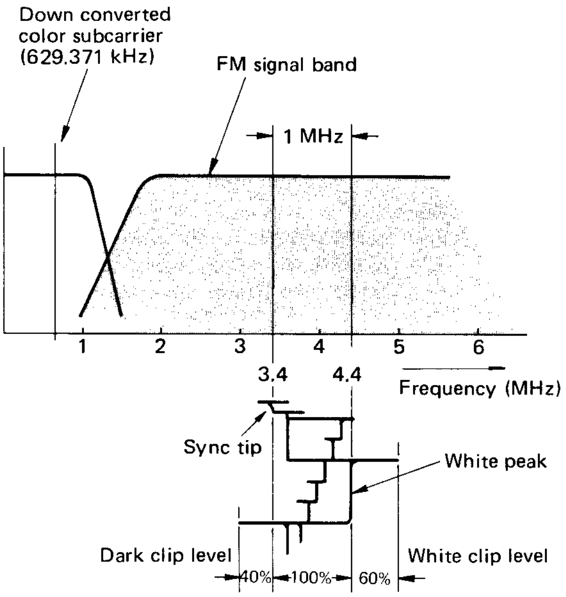


Fig. 1-42 Recording spectrum

1.3.6 FM signal recording amp. characteristics (REC AMP)

Current:

More than 3.8 MHz: Optimum saturation recording current
2 MHz : 3 ± 1 dB
1 MHz : 6 ± 1 dB
Less than 1 MHz : Flat characteristics

Note: 0 dB at 3.8 MHz

1.3.7 FM signal head current (VIDEO HEAD)

Specified to be within ±1.5 dB of 4 MHz optimum recording current.

1.4 LUMINANCE SIGNAL PLAYBACK SYSTEM

This system functions to return the signals recorded on the tape to a form as close as possible to the video input signals. The simplified block diagram is shown in Fig. 1-43.

The low level FM signals played back by the two video heads are combined into a single FM signal by the switching amplifier. After amplification to the required frequency characteristic, a highpass filter attenuates the down converted color signal and passes only the FM luminance signal. This HPF has the same response as that of the recording system.

Variations in the playback FM signal level due to mechanical stretching and contraction of the tape, and irregularities in tape to head contact, are corrected by the limiter circuit. The signal is amplified more than 80 dB to permit precise demodulation. A double limiter circuit is employed in order to prevent black/white reversal effects.

In the following stages, the demodulator and lowpass filter return the luminance signal to its AM form. The de-emphasis circuit reverses the emphasis applied during recording. From this point, the signal goes to the mixer where it is mixed with the playback color signal to become the video output signal.

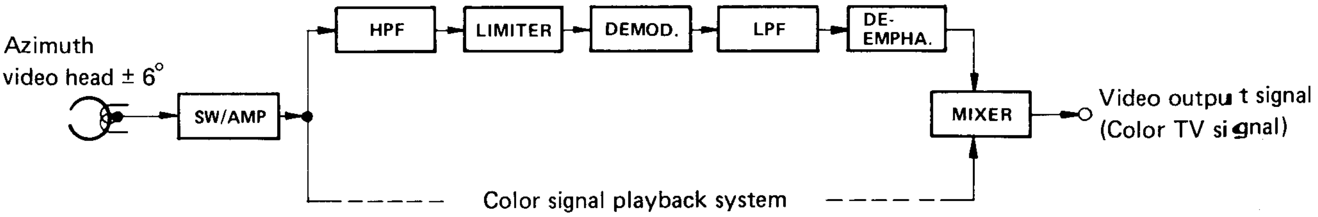
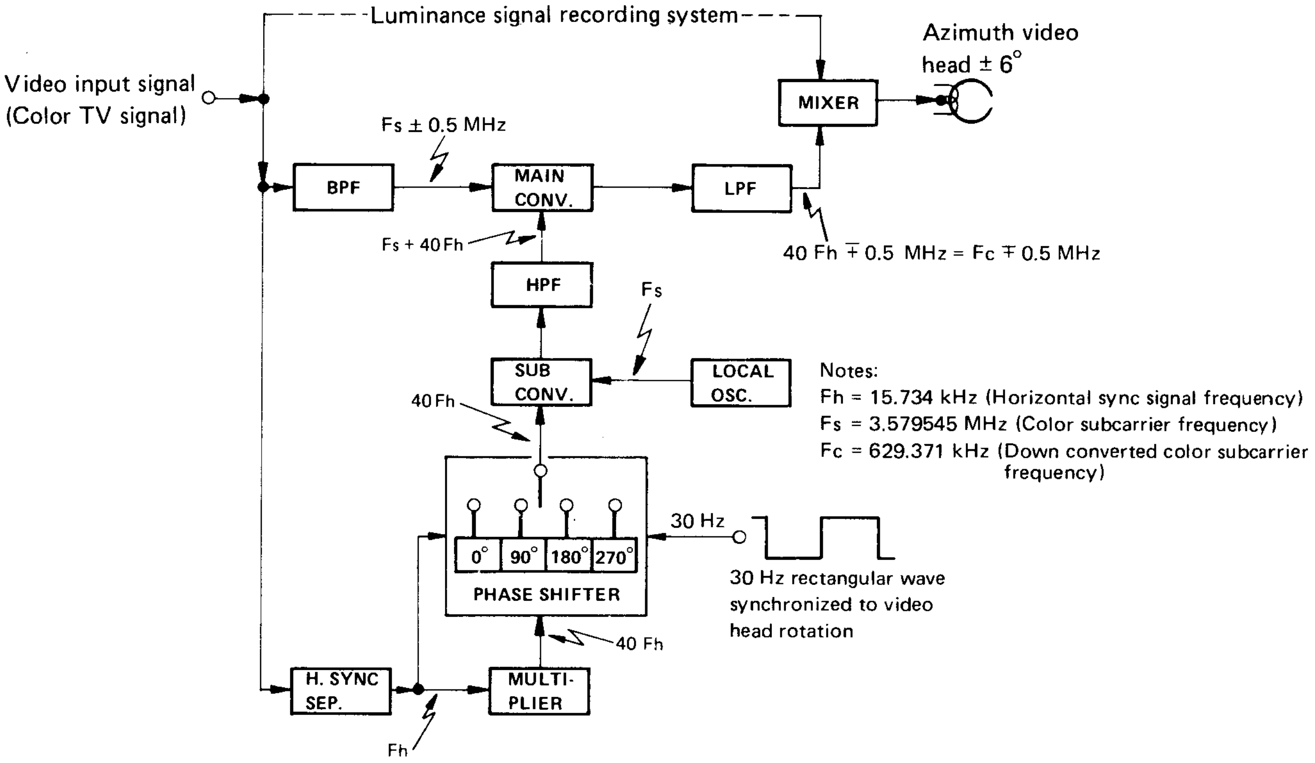


Fig. 1-43 Luminance signal playback system

1.5 COLOR SIGNAL RECORDING SYSTEM


Luminance signal recording system
Video input signal
(Color TV signal)
Azimuth video head ± 6°
MIXER
Fs ± 0.5 MHz
BPF
MAIN CONV.
LPF
Fs + 40Fh
40 Fh ∓ 0.5 MHz = Fc ∓ 0.5 MHz
HPF
Fs
SUB CONV.
LOCAL OSC.
40Fh
0°
90°
180°
270°
PHASE SHIFTER
30 Hz
30 Hz rectangular wave synchronized to video head rotation
40 Fh
H. SYNC SEP.
MULTIPLIER
Fh

Notes:
Fh = 15.734 kHz (Horizontal sync signal frequency)
Fs = 3.579545 MHz (Color subcarrier frequency)
Fc = 629.371 kHz (Down converted color subcarrier frequency)

Fig. 1-44 Color signal recording system

This is a direct recording system using a down converted phase shifted color signal. The phase shift system removes color crosstalk which cannot be completely eliminated by the azimuth video heads. Fig. 1-44 illustrates a simplified block diagram of this system.

A bandpass filter (BPF) extracts the color component from the input video signal and supplies it to the main converter.

At the same time, the input signal also goes to the horizontal sync separator, which supplies the 15.734 kHz (Fh) to the multiplier and phase shift circuits. Via the phase shifter, the 40 Fh CH-1 track component is advanced in phase each line (1 H) and supplied to the sub converter, while the CH-2 component is delayed in phase 90° every line (1 H). A 30 Hz rectangular wave synchronized to the video head rotation is used for differentiating between the CH-1 and CH-2 components. Each line is also controlled by the Fh input.

The local oscillator produces the color subcarrier frequency 3.579545 MHz (Fs). At the sub converter, the goes to the sub converter. At the sub converter, the 40 Fh and Fs are frequency converted to become (Fs + 40 Fh). This is supplied through a highpass filter to the main converter. Also supplied to the main converter are the color signal Fs ± 0.5 MHz and carrier wave (Fs + 40 Fh). These are down converted to become (40 Fh ∓ 0.5 MHz) which through a lowpass filter goes to the mixer for mixing with the FM luminance signal. The result is applied to the video heads.

In other words, the 3.579545 MHz (Fc) color subcarrier is converted to a low band of 629.371 kHz (40 Fh). The down converted color signal is then recorded directly using the FM luminance signal as AC bias.

1.5.1 Color crosstalk correction by phase shift system

While the CH-1 track component is advanced 90° every line and recorded, the phase of the CH-2 track component is dilayed 90° every line. Fig. 1-45 illustrates the principle of this phase shift system.

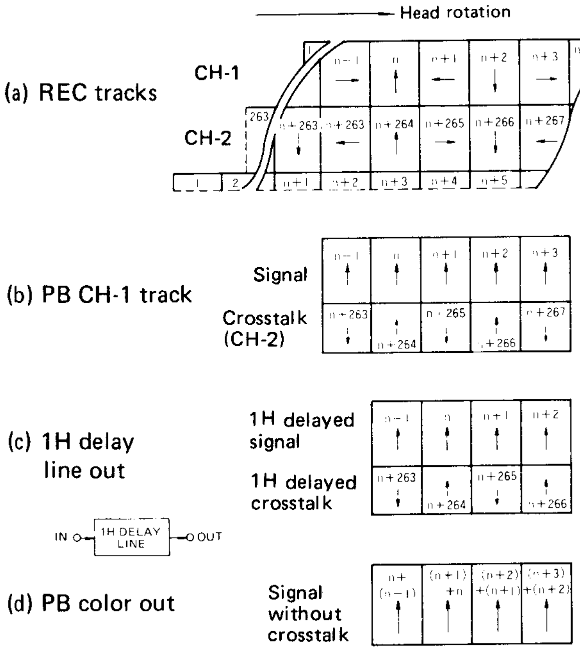

Head rotation
(a) REC tracks
CH-1
CH-2
n−1
n
n+1
n+2
n+3
n+4
n+263
n+264
n+265
n+266
n+267
(b) PB CH-1 track
Signal
Crosstalk (CH-2)
(c) 1H delay line out
1H delayed signal
1H delayed crosstalk
IN
1H DELAY LINE
OUT
(d) PB color out
Signal without crosstalk

Fig. 1-45 Phase shift system

In the figure, (a) indicates the phase shifted recording pattern. The CH-1 head pattern phase is advanced 90° every line. The phase of the CH-2 head pattern is delayed every line.

During playback, when the CH-1 head picks up a portion of the CH-2 track signal, this becomes the crosstalk component. The main signal is delayed 90° every line from the CH-1 track, and this output is shown by (b). The dotted arrows indicate the crosstalk component and, as can be noted, the phase reverses every line.

Passing signal (b) through a 1 H delay line yields signal (c). In comparing signals (b) and (c), the main signal phase is the same every line, but the crosstalk phase reverses. Therefore, by mixing signals (b) and (c), the crosstalk component of the adjacent track can be removed to result in the playback color signal (d).

In other words, the signal is recorded by the phase shift system and during playback, it is mixed with the signal through a 1 H delay line to remove crosstalk.

Crosstalk in the playback color signal (d) effectively becomes zero, while the main signal is enhanced to improve S/N. Also, the CH-2 head playback phase is advanced 90° every line (opposite to recording), producing the same effect. A digital type system is used for phase shifting.

1.5.2 Down converted color subcarrier frequency

The color subcarrier frequency (Fs) can be expressed as:

Fs = 1/2Fh x n (n = odd number: 455)
= 3.579545 MHz

A frequency interleaving system (line offset system) is used. This avoids serious color noise when the color signal is displayed on a monochrome TV receiver.
Fig. 1-46 shows this color signal spectrum.

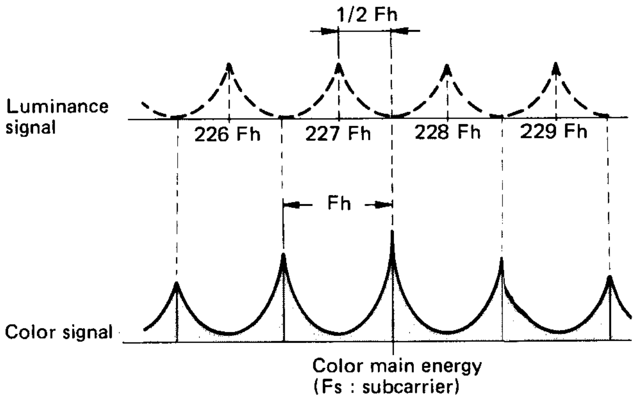

1/2 Fh
Luminance signal
226 Fh
227 Fh
228 Fh
229 Fh
Fh
Color signal
Color main energy (Fs : subcarrier)

Fig. 1-46 Spectrum of colorsignal

In the phase shift system, the CH-1 component of the down converted color signal is advanced in phase 90° every line, deviated by plus 1/4 Fh, and distributed at 1/2 Fh intervals centered on the Fc (down converted color subcarrier) component. The CH-2 track component is delayed in phase 90° every line, deviated by minus 1/4 Fh, and distributed at 1/2 Fh intervals centered on Fc. This spectrum is shown in Fig. 1-47.

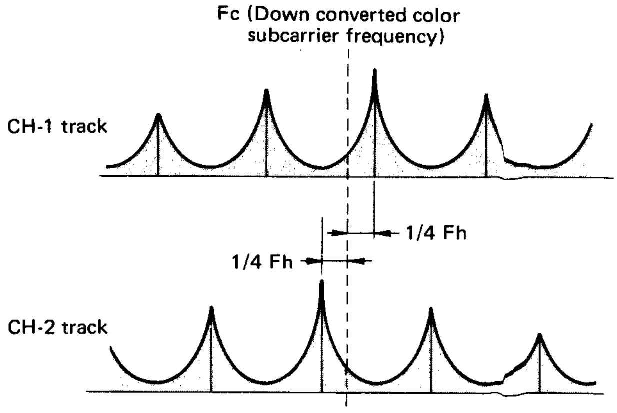

Fc (Down converted color subcarrier frequency)
CH-1 track
1/4 Fh
1/4 Fh
CH-2 track

Fig. 1-47 Spectrum of down converted color signal

The FM luminance and down converted color signals are mixed to become the recording current. When recorded and played back using magnetic tape, which prossesses 3-dimensional distortion and nonlinearity, interference in the form of Fo + 2FDC (Fo : FM carrier; FDC : down converted color signal) becomes introduced and cannot be ignored. When the 2FDC component is detected and demodulated, beat becomes produced with respect to the luminance signal and appears in the picture. Therefore, as with the color signal, Fc (down converted color subcarrier frequency) must be selected so that the frequency of the 2FDC component becomes interleaved (1/2 offset) in relation to the luminance signal.

When Fc is determined at 40 Fh, the 2 FDC spectrum of the CH-1 track component appears at (+1/2 Fh) and in the CH-2 track distribution, the 2 FDC spectrum appears at (nFh − Fh).

Fig. 1-48 shows the 2 FDC component spectrum with respect to the playback luminance signal at this time.

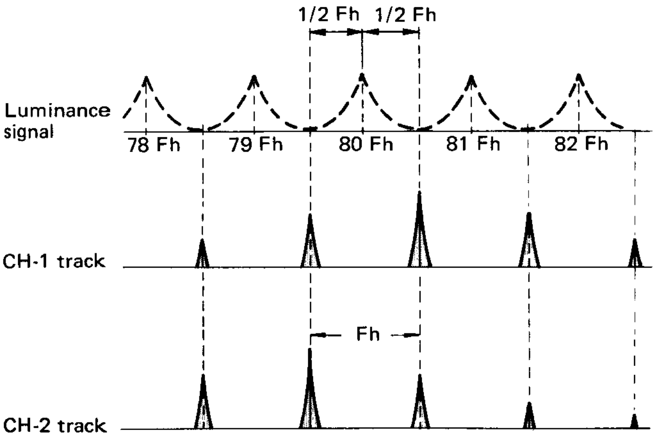


Fig. 1-48 2 FDC playback spectrum

The 2 FDC components for both CH-1 and CH-2 become interleaved (1/2 line offset) with respect to the luminance signal and thereby visually reduced. The 629.371 value was selected for both reducing noise and in consideration of color bandwidth.

1.5.3 Color signal recording bandwidth

Response curves for the bandpass and lowpass filters are indicated in Fig. 1-49.

Constant current characteristics are possessed by the down converted color signal recording current.

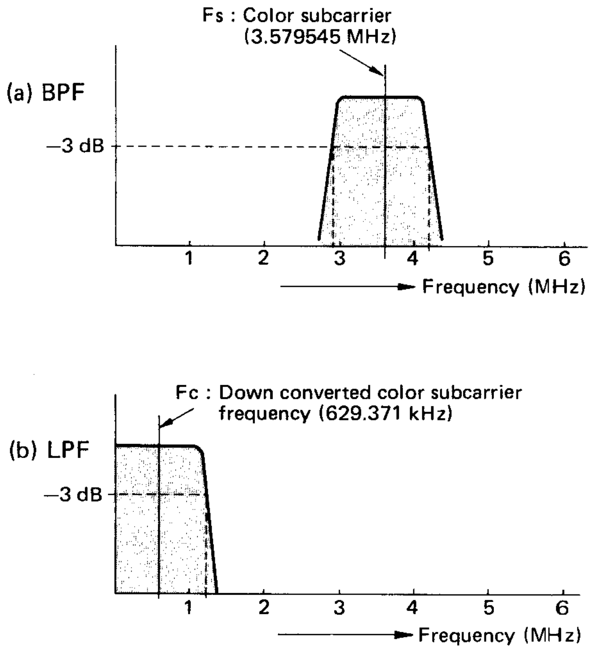


Fig. 1-49 Color signal recording bandwidth

1.6 COLOR SIGNAL PLAYBACK SYSTEM

The color signal playback system performs essentially the opposite function as the recording system. In addition, however, important corrections must be performed for color signal frequency and phase errors introduced by variations in tape speed and head rotation, and elasticity of the tape.

Fig. 1-50 indicates an abbreviated block diagram of this system.

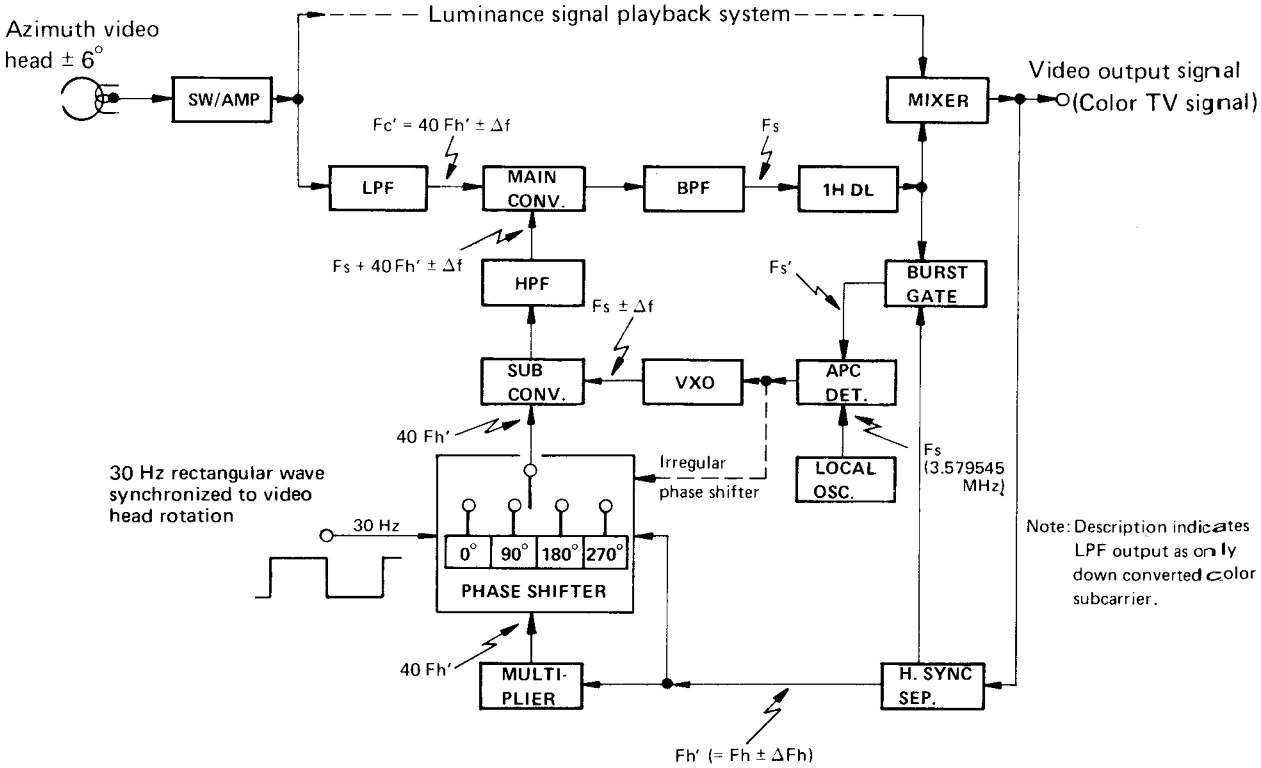
Though a lowpass filter, the down converted color signal goes to the main converter. At this time, the down converted color subcarrier (Fc) contains an error component (40 Fh' ± Δf) due to mechanical factors of the heads and tape. Fh' varies with the tape speed as Fh ± ΔFh. Δf is the instantaneous error caused by head rotation irregularities and tape elongation and contraction.

The 40 Fh' frequency deviation component is compensated by supplying the video output signal to the horizontal sync separator, multiplier and phase shifter, and 40 Fh' to the sub converter. This forms the AFC (automatic frequency compensator) loop.

In the APC (automatic phase compensator) loop, the ± Δf phase error component is compensated by comparing the burst component of the up converted playback color signal with the subcarrier frequency from the local oscillator and APC detector. A variable crystal oscillator (VXO) produces (Fs ± Δf) which goes to the sub converter. As a result, (Fs + 40 Fh' ± Δf) is supplied as the main converter carrier input from the sub converter through a highpass filter.

By frequency conversion with Fc, the color subcarrier frequency of 3.579545 MHz, which is free from frequency and phase deviations, becomes obtained through a bandpass filter. In the opposite manner as with recording, the phase shifter delays the CH-1 track phase 90° every line, advances the CH-2 track phase 90° every line and 40 Fh' is supplied to the sub converter. The playback color signal through the main converter and bandpass filter is applied to a 1 H delay line for removing crosstalk. Characteristics of the lowpass and bandpass filters are the same as those for recording (**Fig. 1-49**).

At the mixer, the playback color and luminance signals are mixed to become the video output signal.


Azimuth video head ± 6°
Luminance signal playback system
SW/AMP
MIXER
Video output signal (Color TV signal)
Fc' = 40 Fh' ± Δf
Fs
LPF
MAIN CONV.
BPF
1H DL
Fs + 40Fh' ± Δf
HPF
Fs'
BURST GATE
Fs ± Δf
SUB CONV.
VXO
APC DET.
40 Fh'
Irregular phase shifter
LOCAL OSC.
Fs (3.579545 MHz)
30 Hz rectangular wave synchronized to video head rotation
30 Hz
0°
90°
180°
270°
PHASE SHIFTER
40 Fh'
MULTI-PLIER
H. SYNC SEP.
Fh' (= Fh ± ΔFh)

Note: Description indicates LPF output as only down converted color subcarrier.

Fig. 1-50 Color signal playback system

1.7 CONTROL SIGNAL RECORDING SYSTEM

Control signal waveform, polarity and video head relationships are indicated in Fig. 1-51.

Phase of the control signal is the same as the vertical sync signal rise component of the CH-1 track. The positive pulse voltage is the reference 30 Hz.

The control signal is recorded on the control track above the saturation recording level.

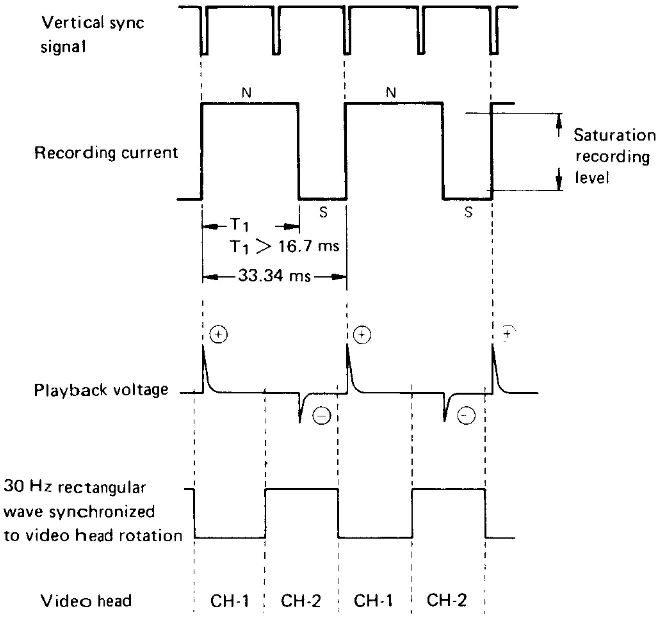

Vertical sync signal
N
N
Recording current
Saturation recording level
T1
S
S
$T_1 > 16.7$ ms
33.34 ms
⊕
⊕
⊕
Playback voltage
⊖
⊖
30 Hz rectangular wave synchronized to video head rotation
Video head
CH-1
CH-2
CH-1
CH-2

Fig. 1-51 Control signal

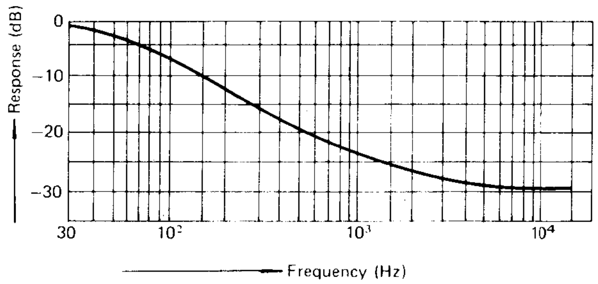
1.8 AUDIO SIGNAL RECORDING SYSTEM

1.8.1 Audio signal recording level

Audio signal is recorded on the audio track to the defined level using an AC bias current recording system.

1.8.2 Audio signal recording current characteristics

The equalizing amplifier controls the recording current in order to obtain a flat frequency characteristic in the reproduced output. See Fig. 1-52.



$T_1 = 3180\,\mu$sec, $T_2 = 120\,\mu$sec

Fig. 1-52 Audio equalizing frequency characteristics

1.9 CASSETTE

1.9.1 Video tape

Length : The relationship between tape length and time for recording and playback can be defined by the formula:

$$L = [2.02t + 2]^{+3}_{0}$$

where, L : tape length (m)

t : recording or playback time (minutes)

Note: L shall be an integer obtained after all decimals produced in calculation are raised. (See "Reference Table".)

Width : 12.65 ± 0.01 mm

Fluctuation : less than 6 μm

Thickness : 19^{+1}_{-2} μm

Coercivity : 600 oersted class (nominal)
Optimum recording current shall not differ from the standard tape.

[Reference Table]

Kinds of blank cassettes

Kind of cassette	Recording or playback time	Length of video tape
T-120	120 min.	246^{+3}_{0} m
T-90	90 min.	185^{+3}_{0} m
T-80	80 min.	165^{+3}_{0} m
T-60	60 min.	125^{+3}_{0} m
T-40	40 min.	84^{+3}_{0} m
T-30	30 min.	64^{+3}_{0} m
T-20	20 min.	44^{+3}_{0} m

1.9.2 Leader tape and Trailer tape

Length : In case time for recording or playback is:
over 60 minutes : 170 ± 20 mm
just or under 60 minutes : 150 ± 20 mm

Width : 12.65 ± 0.03 mm

Thickness : 40^{+5}_{-25} μm

Material : Polyester film

Transparency : more than 50%

Length of splicing: 12 ~ 19 mm

Gap of splicing : 0 ~ 70 μm

Splicing force : more than 3 kg

1.9.3 Reel

Outside diameter : 89 ± 0.2 mm

Hub diameter : In case time for recording or playback is:
over 60 minutes : 26 ± 0.15 mm
just or under 60 minutes : 62 ± 0.2 mm
(If just or under 30 minutes, it can be 70 ± 0.2 mm.)

E-value : more than 1.5 mm

1.9.4 Simplified illustrations

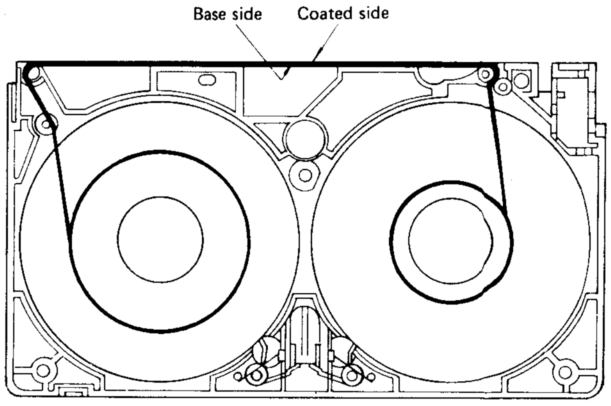

Base side
Coated side

Fig. 1-53 Tape winding and tape path

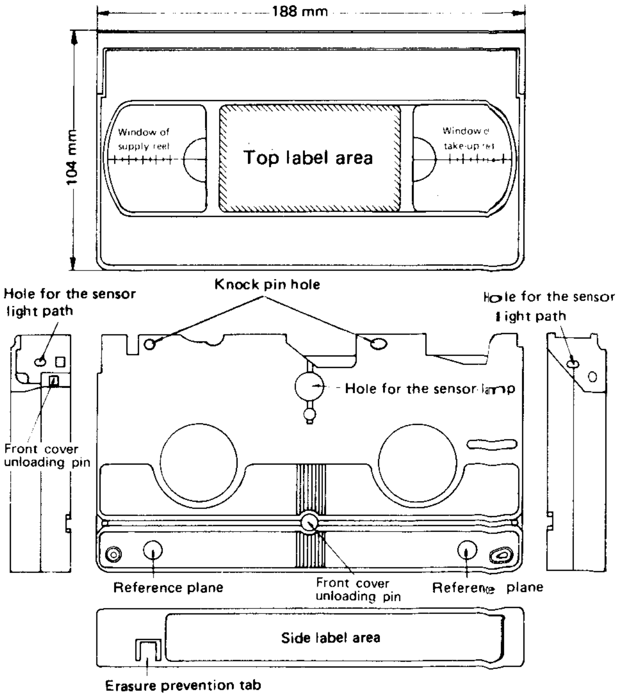

188 mm
104 mm
Window of supply reel
Top label area
Window of take-up reel
Hole for the sensor light path
Knock pin hole
Hole for the sensor light path
Hole for the sensor lamp
Front cover unloading pin
Reference plane
Front cover unloading pin
Reference plane
Side label area
Erasure prevention tab

Fig. 1-54 Cassette appearance

SECTION 2
MECHANISM DESCRIPTION

2.1 TAPE TRANSPORT SYSTEM

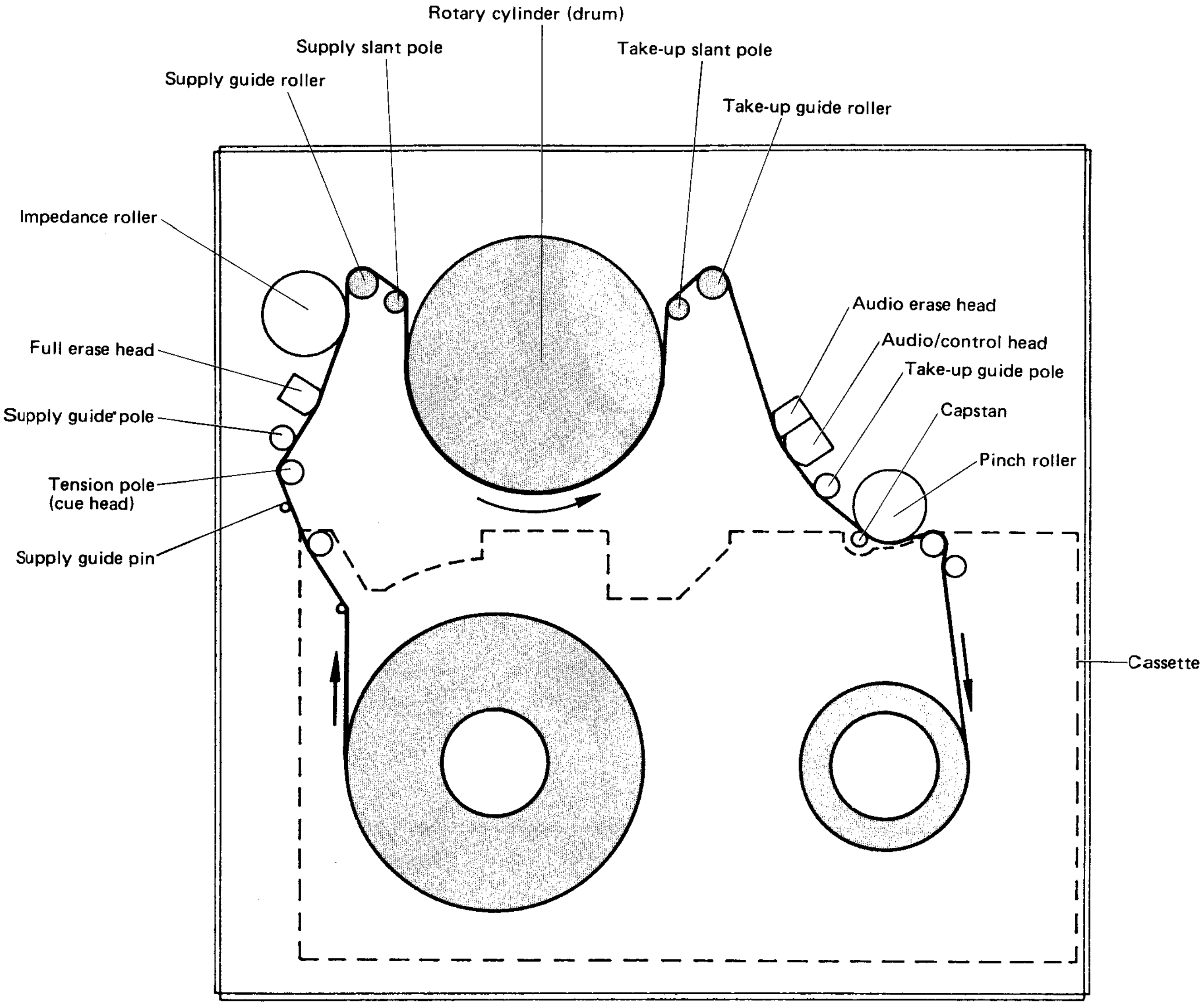

Rotary cylinder (drum)
Supply slant pole
Take-up slant pole
Supply guide roller
Take-up guide roller
Impedance roller
Full erase head
Supply guide pole
Tension pole
(cue head)
Supply guide pin
Audio erase head
Audio/control head
Take-up guide pole
Capstan
Pinch roller
Cassette

Fig. 2-1 Tape transport system

As the designation implies, the most basic function of this system is to transport the tape past the audio and video heads at the specified speed. However, since this model is a helical scan cassette type machine, numerous addition functions are required, which include extracting the tape from the cassette, wrapping it about the cylindrical head drum at a precisely defined angle, and returning the tape to the cassette after it is no longer needed.

To ensure smooth operation, conformance with VHS specifications and "interchangeability" (which allows a tape recorded by one machine to be played by another machine of the same format), the positions, heights and inclination angles of the various fixed and movable tape guides must be adjusted and maintained to close tolerances. The most stringent and difficult of these adjustments have been performed at the factory under controlled conditions. Therefore, in service, it is usually only necessary to perform minor adjustments to compensate for wear and after replacing certain internal parts.

The following description covers the mechanical states for the various operating modes. An adequate understanding of the mechanical processes is essential before attempting to repair or adjust the transport system.

2.2 MAIN COMPONENT OPERATIONS

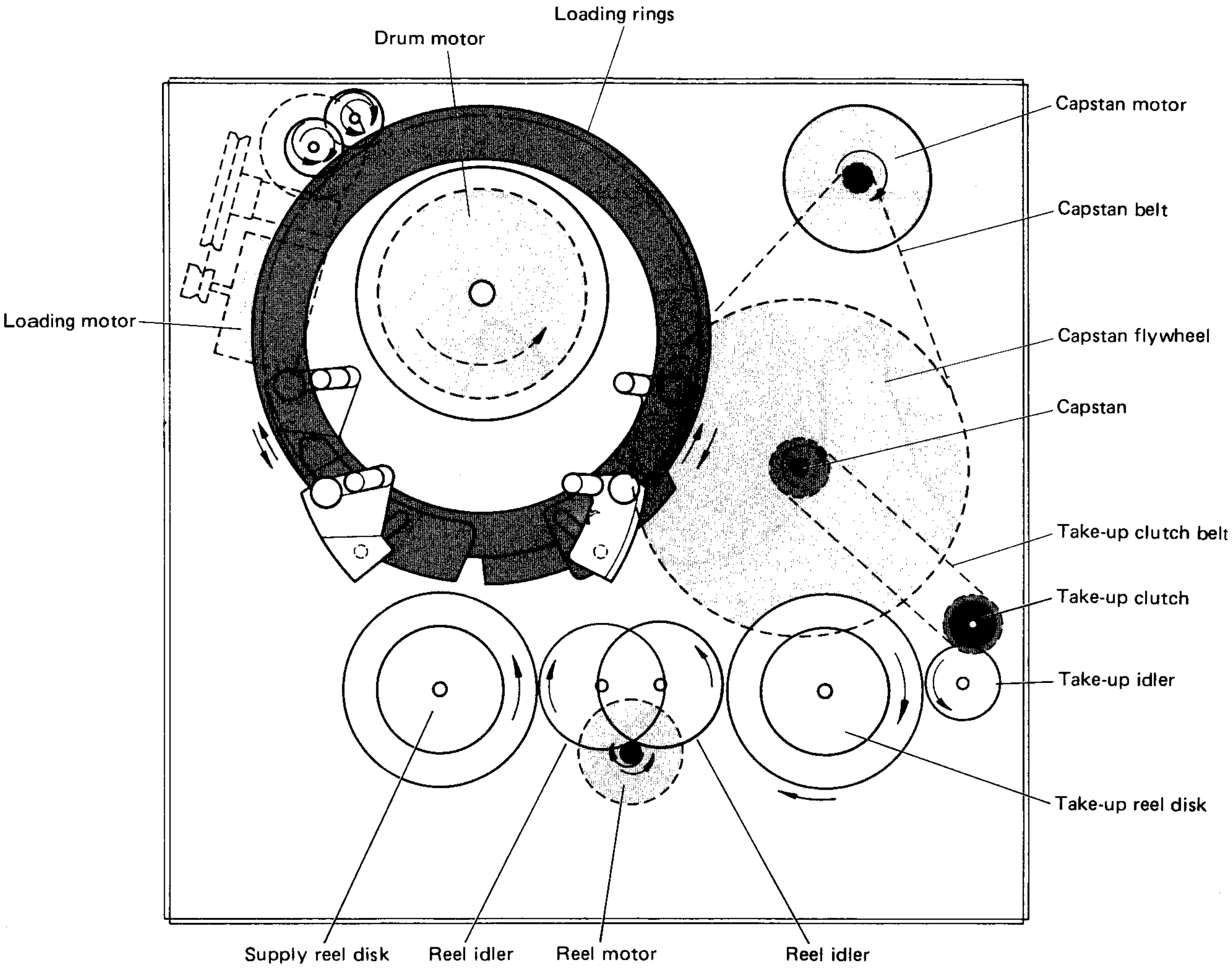

Loading rings
Drum motor
Capstan motor
Capstan belt
Loading motor
Capstan flywheel
Capstan
Take-up clutch belt
Take-up clutch
Take-up idler
Take-up reel disk
Supply reel disk
Reel idler
Reel motor
Reel idler

Fig. 2-2 Motor operations

2.2.1 Drum motor

Drives the rotating video heads.

2.2.2 Capstan motor

Drives the capstan via the capstan belt.

1. Rotation of the capstan motor is applied via the capstan belt to the capstan flywheel, then to the capstan.
2. Capstan flywheel rotation is transmitted by the take-up clutch belt and drives the take-up idler.

2.2.3 Reel motor

Drives the reel idler in forward and reverse directions.

2.2.4 Loading motor

Drives the loading rings in forward and reverse directions.

1. The loading motor rotation goes via the loading belt to the loading gear train composed of worm, wormwheel and relay gears. The supply loading ring is driven via the worm and wormwheel gears, while drive for the take-up loading ring is transmitted by the relay gear.

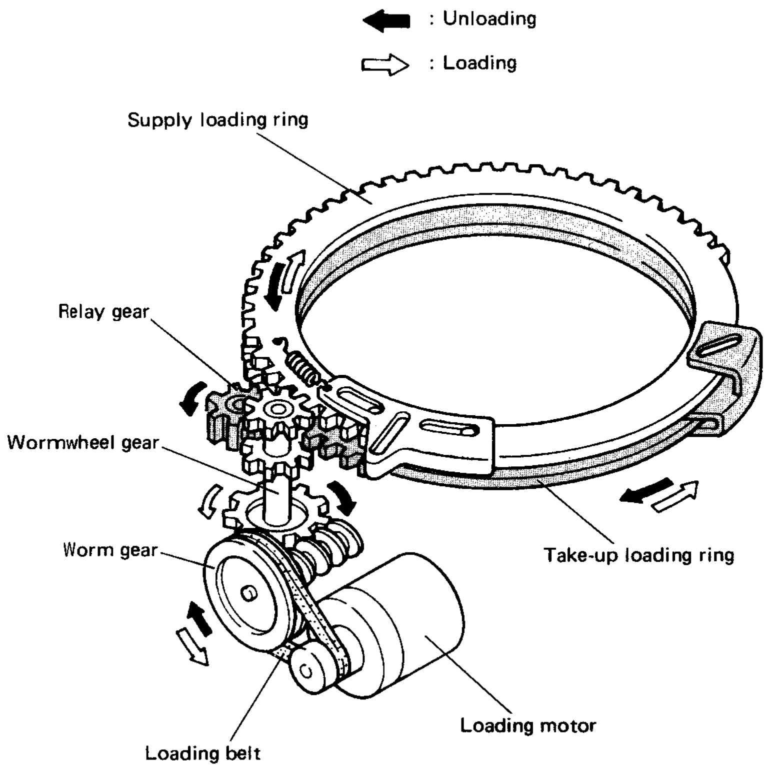

: Unloading
: Loading
Supply loading ring
Relay gear
Wormwheel gear
Worm gear
Take-up loading ring
Loading motor
Loading belt

Fig. 2-3 Loading ring drive mechanism

2.2.5 Brake solenoid

Via the brake arm, this solenoid controls operation of the main brakes and the reel idler functions.

1. When the brake solenoid energizes, the brake arm turns clockwise about the fulcrum. Via the stud at the bottom of the idler plate, the brake arm rotation slides the idler plate in the forward direction. At this time, the stud atop the idler plate releases the main brakes from the reel disks.
2. If the reel idler is positioned at either the supply or take-up reel disk when the brake solenoid switches off, the idler plate returns to its original position and the idler arm returns the reel idler to the center position.

2.2.6 Pinch (roller) solenoid

This controls operation of the pinch roller, take-up idler and back tension arm.

1. When the pinch solenoid energizes, the pinch roller spring holder turns the pinch roller arm counter-clockwise to engage the pinch roller with the capstan.
2. Simultaneously with activation of the pinch solenoid, the pinch roller connect plate slides rearward. The take-up idler, which had been retained by this plate, then moves by spring force to engage the take-up clutch and take-up reel disk.
3. While the back tension brake is engaged, as the pinch solenoid switches off, spring force shifts the back tension cancel plate towards the right. The plate presses against the back tension arm, reducing the application of the back tension brake. This is performed at the start of unloading and during the search (FF and REW) modes.

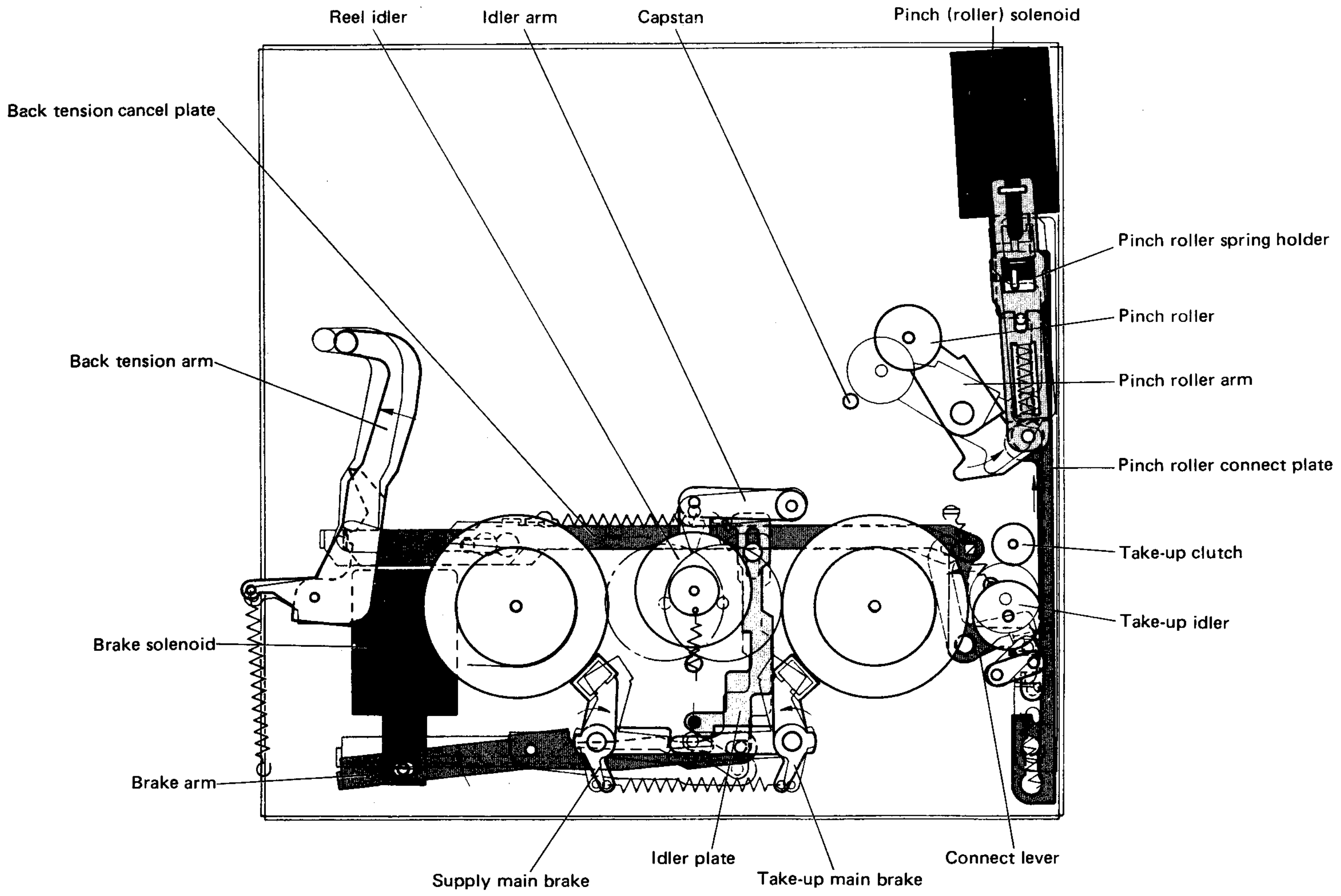

Reel idler
Idler arm
Capstan
Pinch (roller) solenoid
Back tension cancel plate
Pinch roller spring holder
Pinch roller
Back tension arm
Pinch roller arm
Pinch roller connect plate
Take-up clutch
Take-up idler
Brake solenoid
Brake arm
Idler plate
Connect lever
Supply main brake
Take-up main brake

Fig. 2-4 Solenoid operations

2.3 MODE DESCRIPTION

2.3.1 Stop mode

This is the state which allows a cassette to be inserted or removed from the machine. In this mode, the motors and solenoids are not electrically functioning.

At this time, the supply pole base, take-up pole base and tension pole (with cue head) are positioned within the cassette perimeter in readiness for extracting the tape from the cassette. The pinch roller is separated from the capstan and positioned so as not to interfere with cassette insertion or removal.

The main brakes are applied to both the supply and take-up reel disks to prevent uncontrolled rotation. The reel idler is stopped and separated from both the supply and take-up reel disks. The unloading (UL) switch is on and the after loading (AL) switch is off.

NOTES:

1. Short rewind
   In the stop mode, when the EJECT button is pressed for removing a cassette, a short rewind (about 400 m-sec) operation is performed, then the cassette is ejected. Pressing the EJECT button switches the brake solenoid on, at which time the idler plate shifts in the forward direction and the reel idler contacts the reel motor shaft. Simultaneously, the reel motor turns counter-clockwise to force the reel idler toward the supply reel disk. The main brakes are released in this period. This operation serves to avoid tape slackening in the cassette.

2. Short FF
   During the stop mode, if the inserted cassette has the tape completely wound on the supply reel, or after the completion of full rewind, the start sensor detects the transparent leader tape and a short fast forward operation is performed.

   When the transparent section of tape is detected, the brake solenoid switches on, shifting the idler plate in the forward direction. The reel idler contacts the reel motor shaft, at which time the motor turns clockwise to shift the reel idler toward the take-up reel disk. In this period, the main brakes are released. This operation serves to protect the drum assembly (including video heads) from the tape leader section.

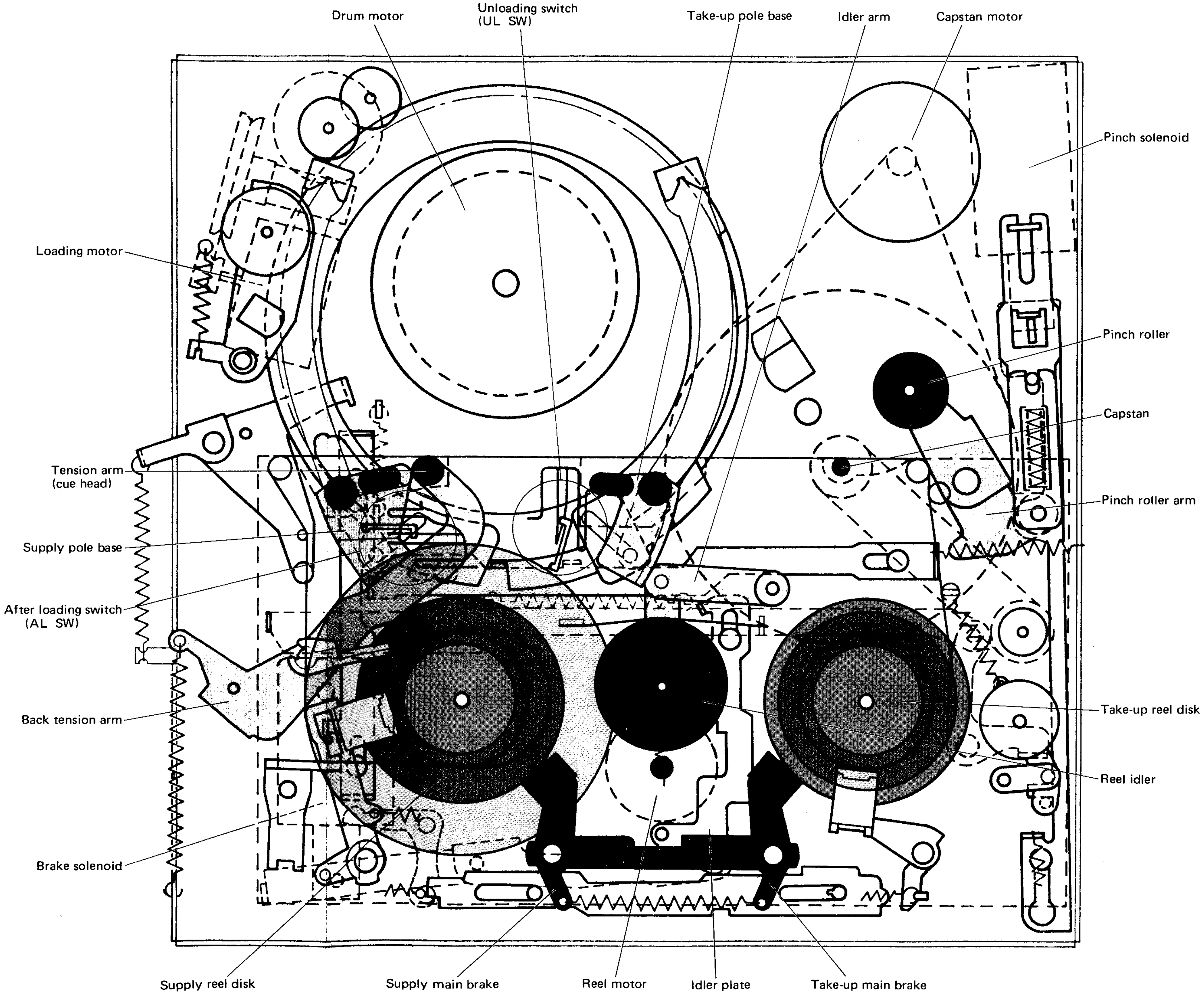

Drum motor
Unloading switch (UL SW)
Take-up pole base
Idler arm
Capstan motor
Pinch solenoid
Loading motor
Pinch roller
Capstan
Tension arm (cue head)
Pinch roller arm
Supply pole base
After loading switch (AL SW)
Back tension arm
Take-up reel disk
Reel idler
Brake solenoid
Supply reel disk
Supply main brake
Reel motor
Idler plate
Take-up main brake

Fig. 2-5 Stop mode

2.3.2 Loading mode

The loading mode covers the process of extracting the tape from the cassette and positioning it in the transport.

In the stop mode, pressing the PLAY button switches on the brake solenoid, and the loading and capstan motors begin rotating. The brake solenoid releases the main brakes from the reel disks, thereby reducing load on the tape. However, since complete absence of load could cause tape slackening due to inertia, the loading tension brake is applied to the supply reel disk and the take-up back tension brake to the take-up reel disk.

Loading motor rotation is transferred via the loading belt to the loading rings. Slide rings are incorporated with the loading rings.

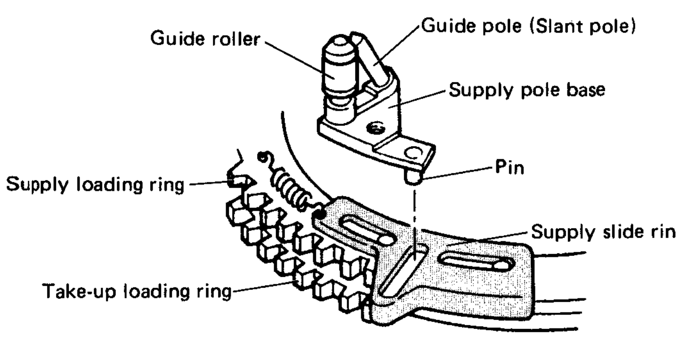

Guide roller
Guide pole (Slant pole)
Supply pole base
Pin
Supply loading ring
Supply slide rin
Take-up loading ring

Fig. 2-6 Loading rings

The pole bases are positioned atop the sub deck. As the pins at the bottoms of the pole bases ride in the slide ring grooves, rotation of the loading rings becomes transmitted directly to the pole bases, which shift in the sub deck guide grooves. At this time, the slant poles of the pole bases and the guide rollers extract the tape from the cassette.

When the take-up loading ring begins turning, spring force shifts the pinch roller arm push plate toward the right. This imparts counter-clockwise rotation to the pinch roller arm, moving the pinch roller slightly towards the capstan and switching off the UL switch. The drum motor then begins rotating.

After the supply pole base shifts, spring force turns the back tension arm counter-clockwise. When the back tension arm strikes the cancel lever, it stops until completion of loading. Then with further movement of the cancel lever, it again turns counter-clockwise by spring force.

As loading continues, the supply pole base presses the erase head arm to carry the tape. When the supply pole base reaches a certain point, spring force returns the erase head arm to its original position and the impedance roller contacts the tape. The impedance roller serves to dampen vertical vibration of the tape, which can contribute to picture jitter and audio wow & flutter.

The pole bases engage the pole guides of the sub deck and stop. However, the loading rings continue to rotate until the switch plate sets the AL switch on.

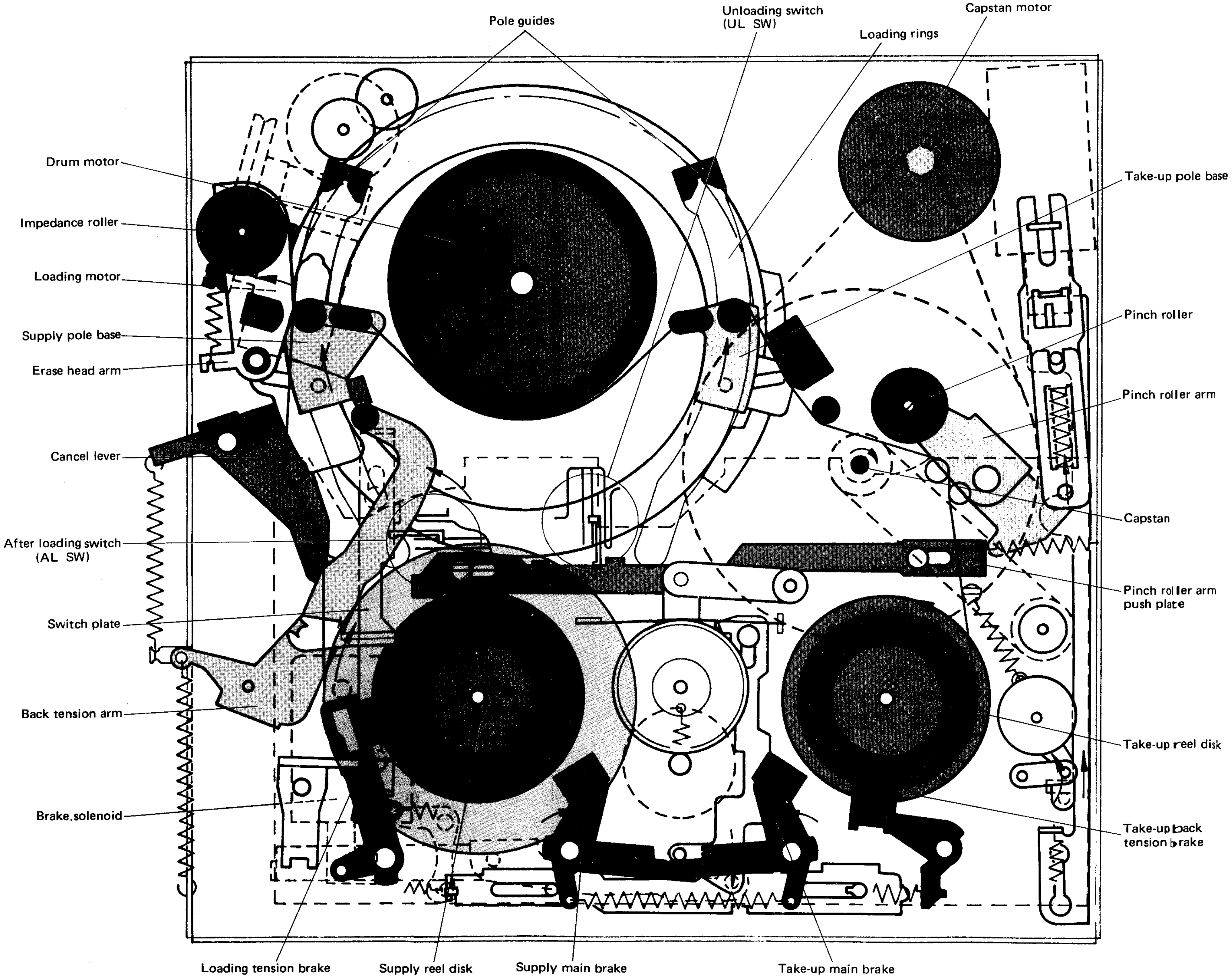

Pole guides
Unloading switch
(UL SW)
Loading rings
Capstan motor
Drum motor
Impedance roller
Loading motor
Supply pole base
Erase head arm
Cancel lever
After loading switch
(AL SW)
Switch plate
Back tension arm
Brake solenoid
Take-up pole base
Pinch roller
Pinch roller arm
Capstan
Pinch roller arm push plate
Take-up reel disk
Take-up back tension brake
Loading tension brake
Supply reel disk
Supply main brake
Take-up main brake

Fig. 2-7 Loading mode

2.3.3 Play mode

1. Normal play and recording

   After the pole bases engage the pole guides, the loading rings continue to turn. The stud at the bottom of the take-up loading ring imparts counter-clockwise rotation to the cancel lever, which shifts the switch plate in the forward direction. This sets the AL switch on, stopping the loading motor and loading rings. At the same time, the switch plate presses and releases the loading tension brake. The switch plate also imparts counter-clockwise rotation to the change lever, shifting the connect plate toward the right and releasing take-up back tension brake.

   The AL switch sets the pinch solenoid on and the take-up idler transfers the take-up clutch rotation to the take-up reel disk. When tape take-up begins, the pinch roller engages the capstan to initiate tape transport.

   When the pinch solenoid energizes, the reel motor turns briefly clockwise, shifting the reel idler toward the take-up reel disk. Since rotation of the take-up reel disk acts to brush aside the reel idler, load is not imposed on the disk. Also, this action is not sufficiently strong to overcome the plate spring force and shift the reel idler toward the supply reel disk.

2. Still and frame advance

   In the play mode, when the STILL button is pressed, the servo system functions to correct the FM noise position in accordance with instructions from the mechacon circuit. The pinch roller and take-up idler remain engaged. At first, the tape is transported toward the take-up reel by intermittent rotation of the capstan motor, then the motor stops.

   At this point, the mechanical state is the same as the normal play mode, but in absence of capstan motor rotation, the tape is stopped. The pinch roller and take-up idler remain engaged, while the drum motor continues to rotate.

   During the still mode, by pressing the FR ADV (frame advance) button, the capstan motor rotates to transport the tape toward the take-up reel. Otherwise, the mechanical state is the same as the still mode.

   Again pressing the PLAY button returns the normal play mode. The capstan motor rotates and tape transport resumes.

3. x2 (double speed)

   During the normal play mode, pressing the x2 button doubles the capstan motor speed. Otherwise, the mechanical state is the same as the play mode. Again pressing the PLAY button returns the normal play mode.

4. Slow speed

   By pressing the SLOW button in the play mode, the capstan motor rotates intermittently to transport the tape toward the take-up reel at reduced speed. Otherwise, the mechanical state is the same as the play mode. Tape speed during the low mode can be adjusted by the front panel SLOW SPEED control. Again pressing the PLAY button returns the normal play mode.

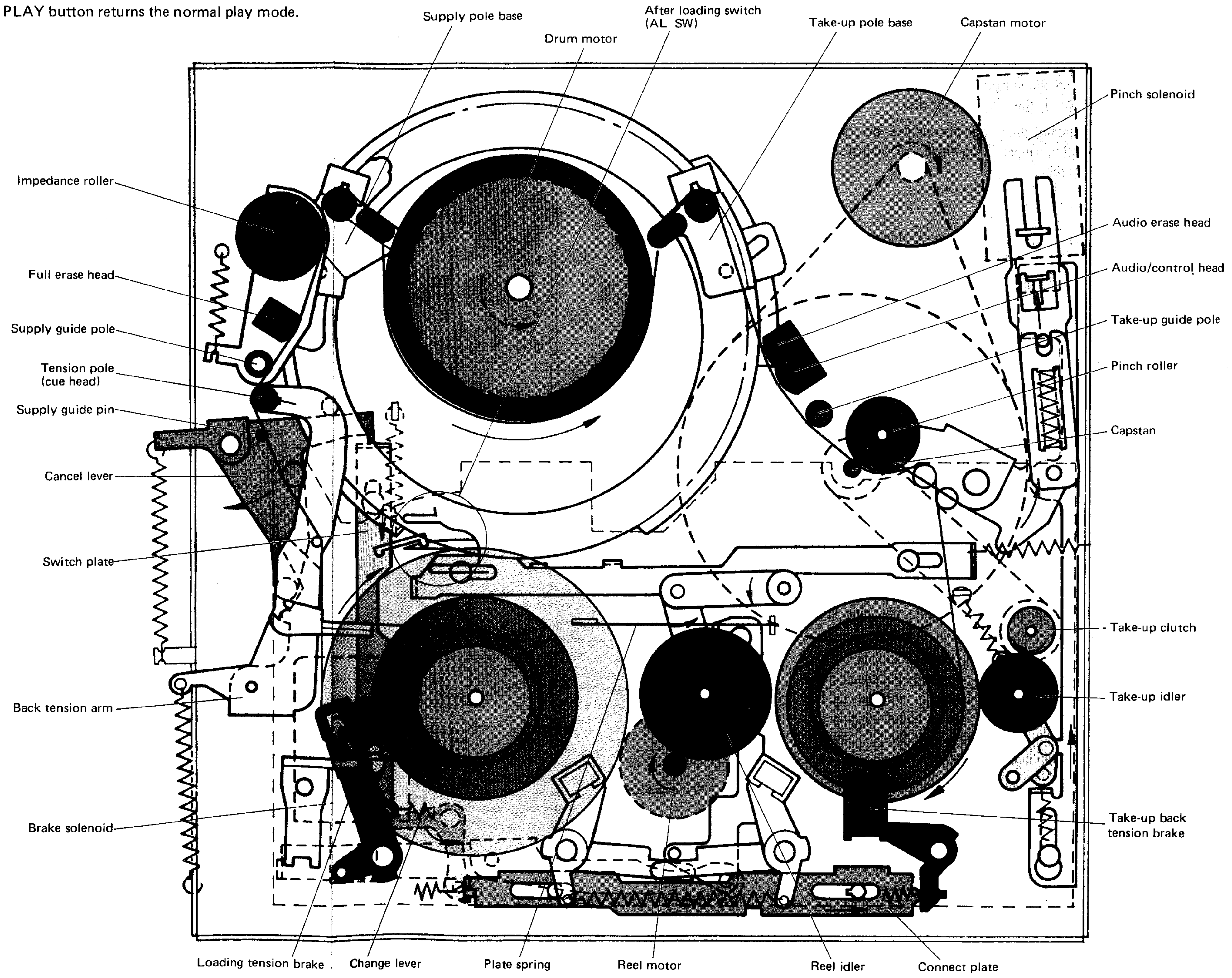

Supply pole base
Drum motor
After loading switch (AL SW)
Take-up pole base
Capstan motor
Pinch solenoid
Impedance roller
Audio erase head
Audio/control head
Full erase head
Take-up guide pole
Supply guide pole
Pinch roller
Tension pole (cue head)
Supply guide pin
Capstan
Cancel lever
Switch plate
Take-up clutch
Take-up idler
Back tension arm
Take-up back tension brake
Brake solenoid
Loading tension brake
Change lever
Plate spring
Reel motor
Reel idler
Connect plate

Fig. 2-8 Normal play mode

5. Recording pause

When the PAUSE button is pressed in the recording mode, the capstan motor rotates slightly in reverse to perform 25 frames back spacing. At the same time, the brake solenoid briefly switches off and the idler plate moves toward the rear, shifting the reel idler from the take-up reel disk to the center position.

Immediately afterwards, the reel motor turns counterclockwise and this shifts the reel idler toward the supply reel disk. Using the reel motor, tape transported by reverse rotation of the capstan becomes taken up by the supply reel.

At completion of tape winding, the brake solenoid again switches off briefly. The idler plate moves rearward to shift the reel idler to the center. The reel motor then turns clockwise to again shift the reel idler toward the take-up reel disk. Tape slack at the take-up side produced during the back space operation becomes absorbed by this process.

The capstan motor stops after back space rotation. At this time, the mechanical state is the same as for recording. The pinch roller and take-up idler remain engaged and the drum motor continues to rotate. However, the capstan motor and tape transport are stopped.

Again pressing the PLAY button returns the recording mode.

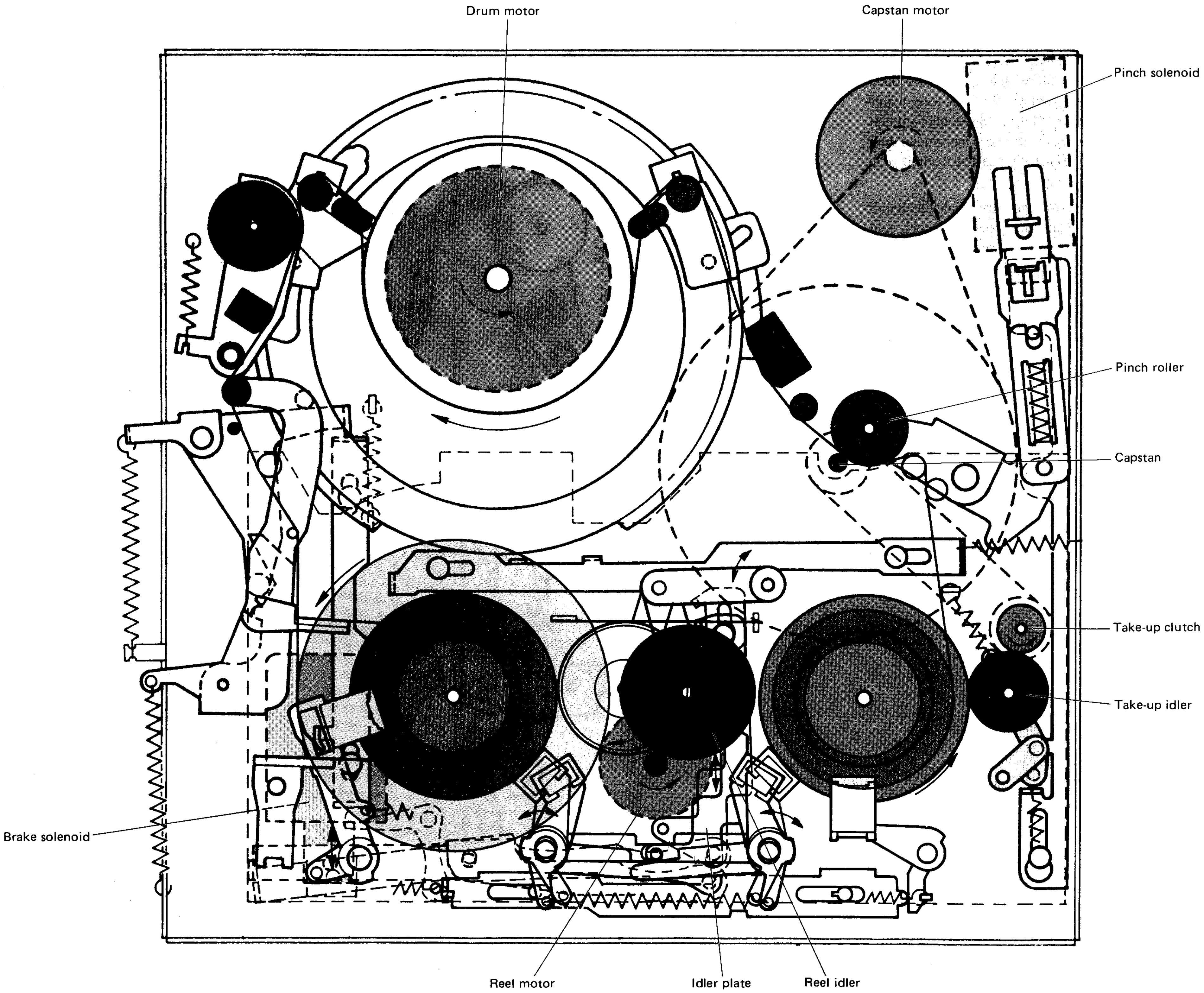

Drum motor
Capstan motor
Pinch solenoid
Pinch roller
Capstan
Take-up clutch
Take-up idler
Brake solenoid
Reel motor
Idler plate
Reel idler

Fig. 2-9 Recording pause mode (process)

6. Search FF

In the normal play mode, holding the FF button depressed switches the pinch solenoid off, while the reel motor turns clockwise at increased speed. The capstan motor continues to rotate.

When the pinch solenoid switches off, the tape transport stops and the back tension cancel plate shifts the back tension arm to reduce back tension. The reel idler transfers the increased reel motor rotation to the take-up reel disk. With back tension reduced, the tape becomes taken up by the take-up reel at about 9 times the normal play speed.

Releasing the FF button briefly sets the brake solenoid to off, applying the main brakes to the reel disks, and the reel motor stops. At the moment the brake solenoid switches off, the reel idler returns to center position, then when the reel motor turns briefly clockwise, the reel idler shifts toward the take-up reel disk.

At the same time, the pinch solenoid switches on, then the brake solenoid again switches on to resume the normal play mode.

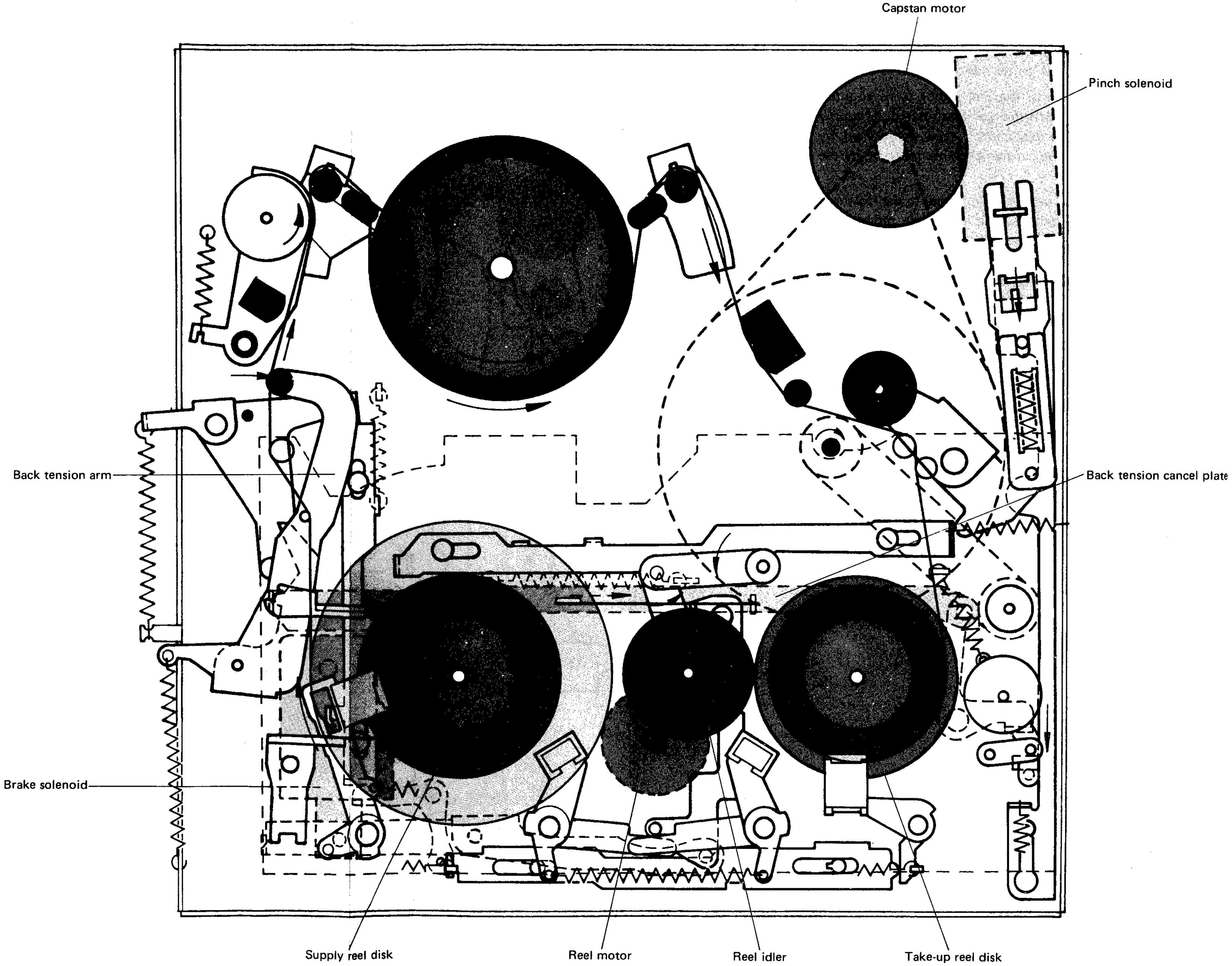

Capstan motor
Pinch solenoid
Back tension arm
Back tension cancel plate
Brake solenoid
Supply reel disk
Reel motor
Reel idler
Take-up reel disk

Fig. 2-10 Search FF mode

7. Search rewind

During the normal play mode, holding the REW button depressed briefly switches off the brake solenoid. The main brakes become applied and the reel idler returns to center.

The brake solenoid returns to on and the reel motor turns counter-clockwise to shift the reel idler toward the supply reel disk. At the same time, the pinch solenoid switches off to stop the tape transport and reduce back tension. The capstan motor also stops.

The reel motor then rotates at increased speed, which is transmitted by the reel idler to the supply reel disk. With back tension reduced, the tape becomes wound on the supply reel and transported at approximately 9 times the normal play speed.

Releasing the REW button briefly switches the brake solenoid off. The main brakes are applied to the reel disks and the reel motor stops. The reel motor then turns briefly clockwise to shift the reel idler from the supply to the take-up reel disk. At the same time, the pinch solenoid switches on and the capstan motor rotates to resume the normal play mode.

During search rewind, both the supply and take-up reel disks rotate at increased speed. After the reel motor stops, they continue to turn due to inertia. However, at this time, tape slack produced at the take-up side becomes impeded by the load produced between the oilless metal bearing and collar of the take-up reel disk.

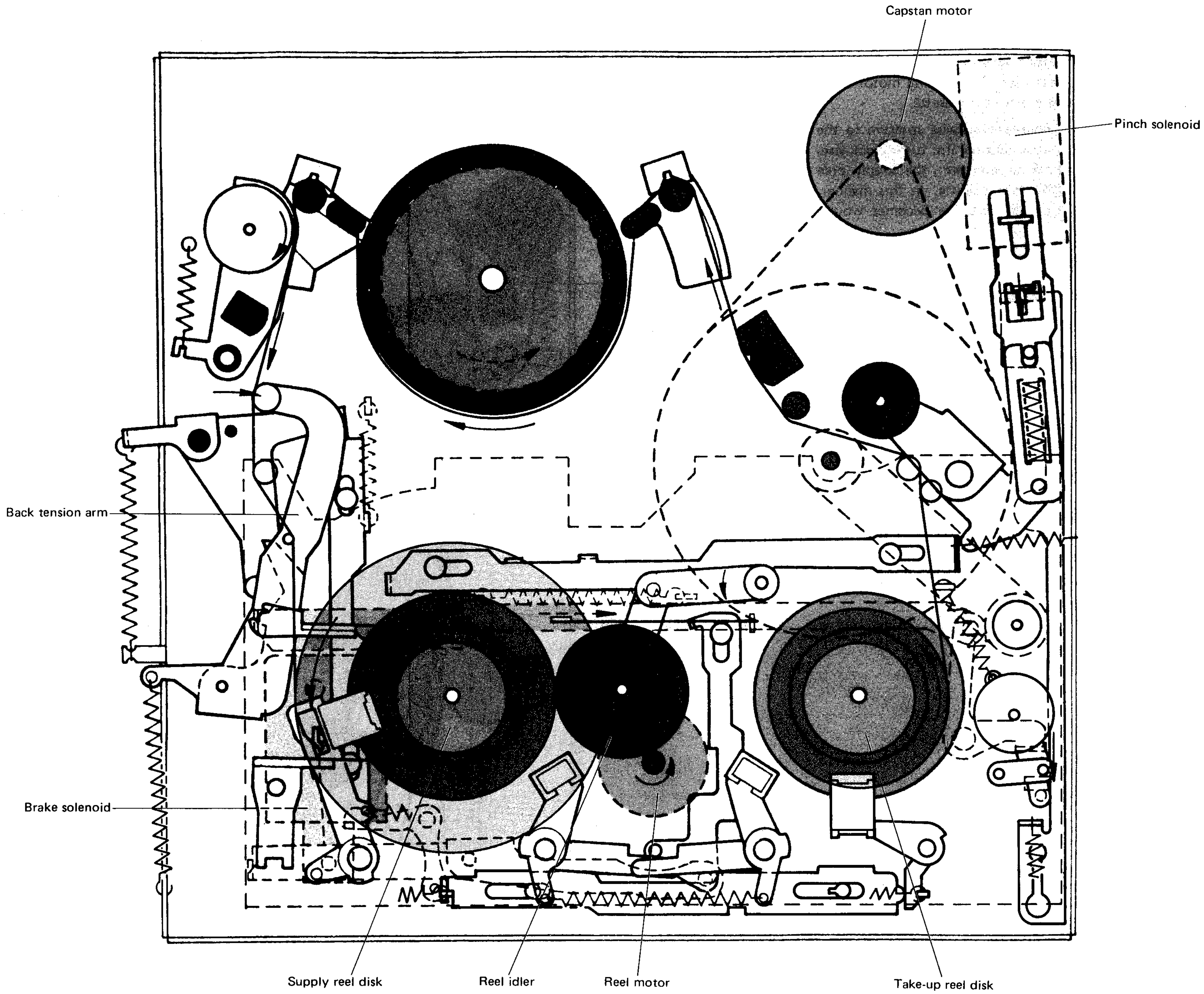


Fig. 2-11 Search REW mode

2.3.4 Unloading mode

At the end of tape in the normal play mode, or if the STOP button is pressed, the pinch and brake solenoids switch off and tape transport stops. The brake solenoid again switches on to release the main brakes, while the reel motor turns counter-clockwise to shift the reel idler toward the supply reel disk. The loading motor turns to move the pole bases toward the cassette.

Spring force imparts counter-clockwise rotation to the cancel lever and the back tension arm turns clockwise. While pressing the back tension arm, the supply pole base proceeds to within the cassette. In this manner, the tape extended from the cassette becomes wound on the supply reel.

When the supply pole base, back tension arm and take-up pole base become positioned within the cassette, the slide ring of the take-up loading ring shifts the pinch roller arm push plate towards the left. This completely separates the pinch roller from the capstan and sets the UL switch on. The loading, reel, capstan and drum motors stop, and the brake solenoid switches off to yield the stop mode.

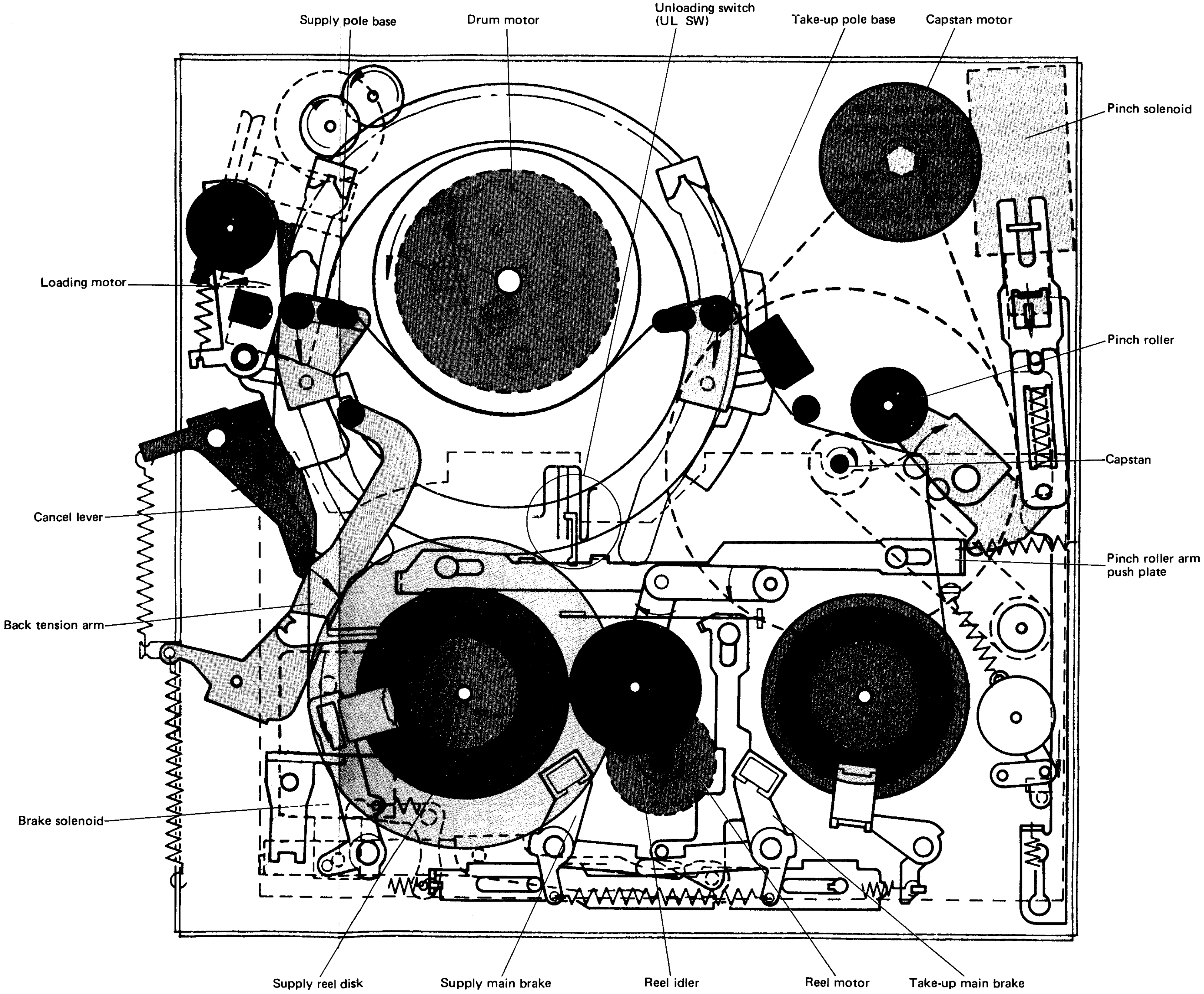

Supply pole base
Drum motor
Unloading switch (UL SW)
Take-up pole base
Capstan motor
Pinch solenoid
Loading motor
Pinch roller
Capstan
Cancel lever
Pinch roller arm push plate
Back tension arm
Brake solenoid
Supply reel disk
Supply main brake
Reel idler
Reel motor
Take-up main brake

Fig. 2-12 Unloading mode

2.3.5 Fast forward (FF) mode

In the stop mode, pressing the FF button sets the brake solenoid on. The main brakes are released, the reel motor turns clockwise, and the reel idler contacts the take-up reel disk. Initially, the reel motor rotates at reduced speed, then at higher speed to transport the tape to the take-up reel. This stepped rotation serves to avoid sudden load on the tape.

The loading tension brake and take-up back tension brake remain engaged in order to impart a fixed tension. This serves to promote both proper tape winding and accurate pickup of the cue signal.

When the STOP button is pressed, the reel motor stops. The brake solenoid switches off and the reel idler returns to center position. At the same time, the main brakes are applied to the reel disks and tape transport stops.

At the end of tape in the FF mode, the end sensor functions to initiate auto rewind.

If the counter SEARCH switch is on, FF becomes performed at reduced speed in the range of 9900 to 0000 as indicated by the counter. This permits more precise stopping at the 0000 point.

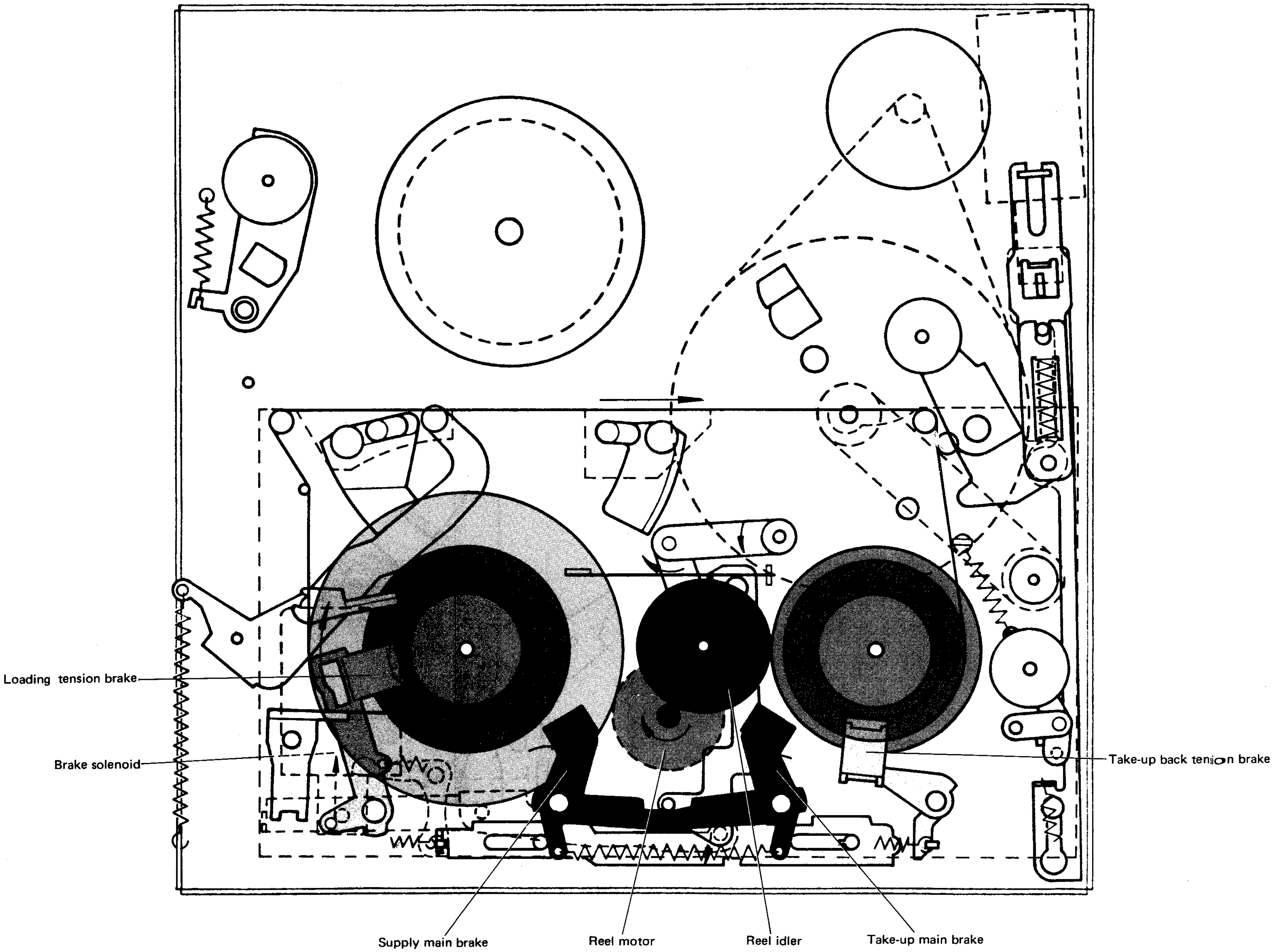

Loading tension brake
Brake solenoid
Take-up back tension brake
Supply main brake
Reel motor
Reel idler
Take-up main brake

Fig. 2-13 FF mode

2.3.6 Rewind (REW) mode

In the stop mode, pressing the REW button sets the brake solenoid on. The main brakes are released and the reel motor rotates counter-clockwise to shift the reel idler toward the supply reel disk. Following this, the reel motor turns at reduced speed, then at higher speed. This is to avoid sudden load on the tape.

The loading tension and take-up back tension brakes remain engaged in order to promote smooth tape winding and allow accurate detection of the cue signal.

When the STOP button is pressed, the reel motor stops. The brake solenoid switches off and reel idler returns to center. At the same time, the main brakes are applied and tape transport stops.

If the beginning of the tape is reached in the rewind mode, the start sensor functions to initiate short FF.

If the counter SEARCH switch is on, rewind is performed at reduced speed in the counter range of 0100 to 0000. This serves to allow more accurate stopping at the 0000 point.

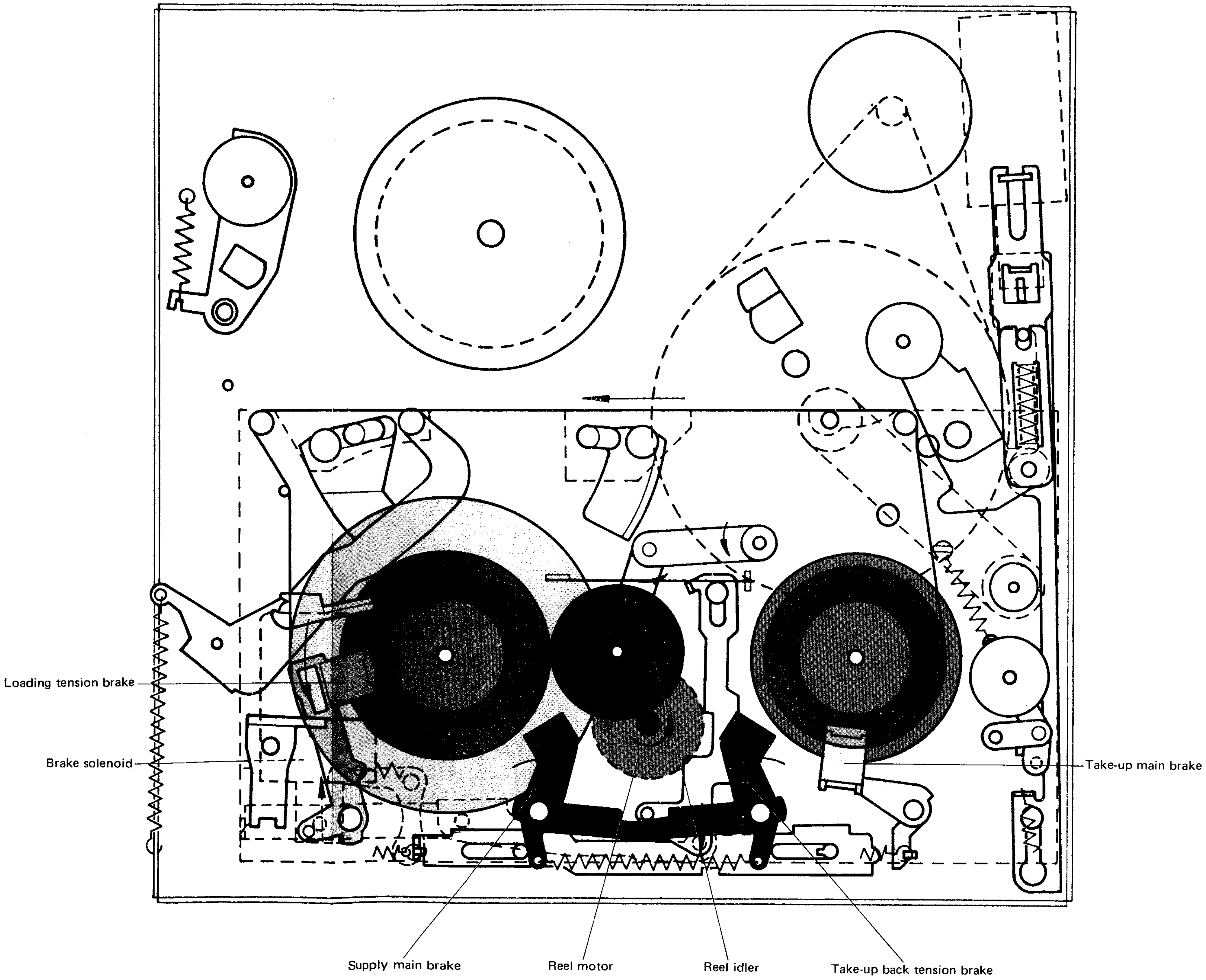

Loading tension brake
Brake solenoid
Take-up main brake
Supply main brake
Reel motor
Reel idler
Take-up back tension brake

Fig. 2-14 REW mode

2.4 CASSETTE HOUSING

This model utilizes a motorized front loading system by which cassette insertion and ejection are performed by the motor of the cassette housing.

2.4.1 Neutral state

The state without a cassette inserted is shown by (a) of Fig. 2-15.

2.4.2 Cassette setting

Setting is performed automatically when a cassette is inserted into the slot.

1. When a cassette is inserted, it presses and raises the two rubber rollers of the roller assembly at the top of the cassette housing. Sprocket gear-2 turns slightly counterclockwise and pulls the chain taut.

   The shutter blocks the photo interrupter, yielding a low signal output, and the cassette motor begins turning in the loading direction. Rotation of the cassette motor is transmitted in the route: cassette belt → worm gear → worm wheel gear → sprocket gear-1 → chain.

   The chain turns counter-clockwise and the roller assembly, coupled to sprocket gear-2, rotates to feed the cassette into the cassette housing. This is indicated by (b) in the figure.

2. As the cassette moves inward, it presses the slide plate and the chain pin of the slide plate engages a link of the chain. The pin is pressed downward by the chain and the cassette becomes lowered into the housing. This is shown by (c).

3. When the cassette is completely lowered, a roller attached to the housing closes the cassette switch. This stops the cassette motor to complete the setting process. The state at this point is indicated by (d).

NOTE: When the cassette switch closes, short brake is applied to the cassette motor, stopping the rotation. Consequently, the mounting position of the cassette switch determines the cassette setting position. Care is therefore needed when replacing the cassette switch. Refer to the mechanical adjustments of Section 4.

2.4.3 Cassette eject

The cassette becomes ejected automatically when the EJECT button is pressed. A short rewind operation is performed at the stop state (UL switch on, brake solenoid off, etc.) in order to absorb tape slack in the cassette.

1. When the EJECT button is pressed, after short rewind, the cassette motor begins turning in the unloading direction. The motor rotation is transmitted in the route: cassette belt → worm gear → worm wheel gear → sprocket gear-1 → chain. The chain engages the chain pin and the cassette is raised.
2. After the rollers of the roller assembly are contacted, they turn clockwise to slide the cassette horizontally outward.
3. At the end of travel, the chain loosens, shifting the shutter. This produces a high signal at the photo interrupter and the cassette motor stops to complete the eject process.

NOTES:

1. During cassette setting, if the cassette switch does not close within 7 seconds after the cassette motor rotates, the eject mode is entered automatically.
2. If an additional 7 seconds elapse before completion of eject, the cassette motor stops and the eject emergency mode is entered. The EJECT button LED flashes and all operating modes are inhibited.
3. If an empty cassette (which does not contain tape) or one with broken tape is inserted, the start and end sensors perform detection and the Eject mode is automatically entered.

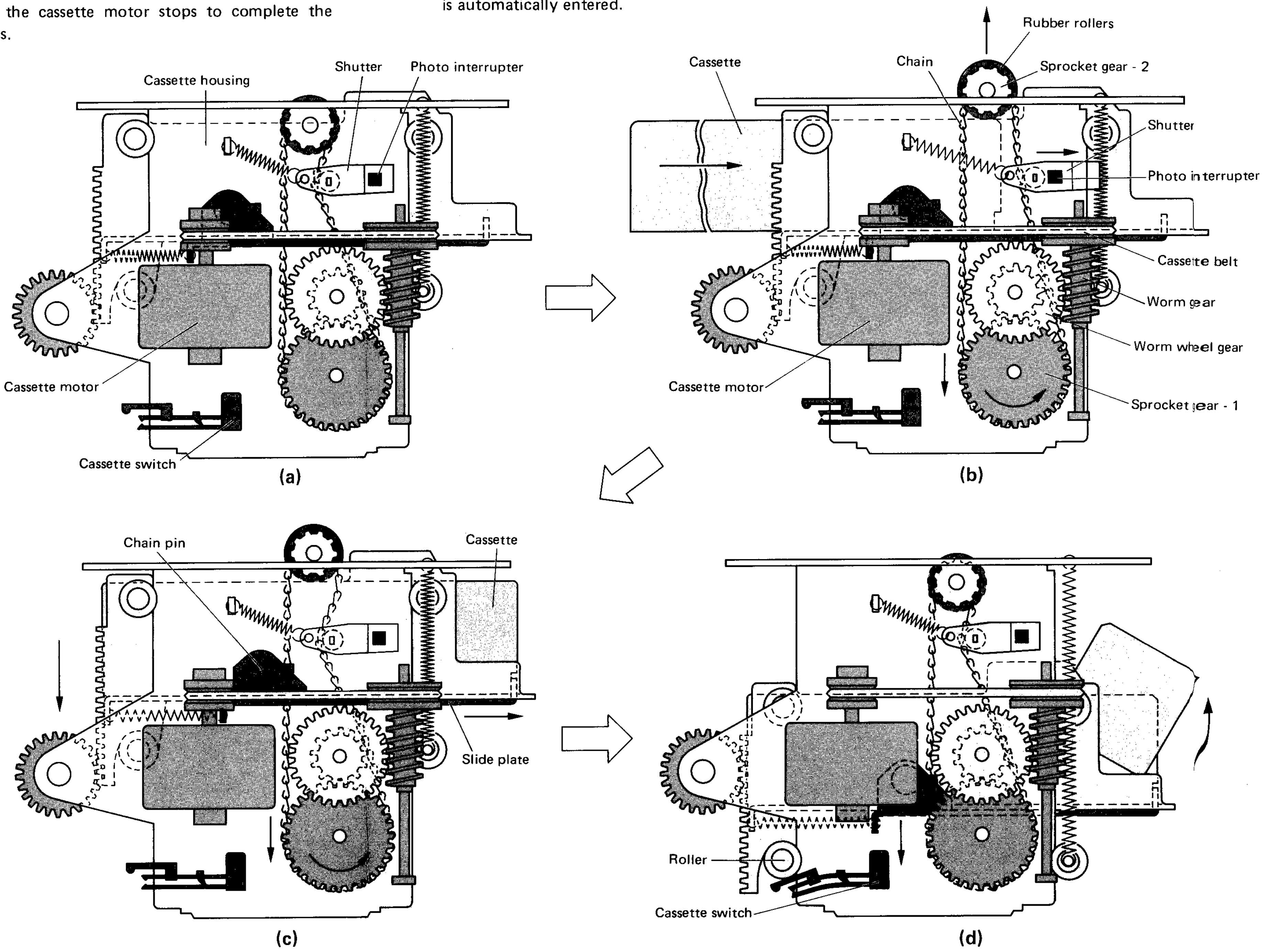


Fig. 2-15 Cassette housing mechanism

SECTION 3
CIRCUIT DESCRIPTION

3.1 MECHANISM CONTROL SYSTEM

3.1.1 General description

The mechacon circuit receives mode command signals from the operation keys and mode detect signals from the various sensors and produces signals for driving the motors and solenoids to set up the required modes. Mode control signals are also sent to the appropriate circuit boards.

These control functions are performed by the central processing unit (CPU) of IC5, which is a one-chip 4-bit microcomputer.

In the block diagram, observe that for the input side of CPU, the CPU input port has only 8 input terminals; Port A is 4-bit and Port B is 4-bit. However, the input from control keys and each sensor and other PCBs totals more than 8 inputs so that it is impossible to supply all of these inputs directly to the CPU.

For this reason, IC3 multiplexer is provided as an input expander. Using the 3-bit bus select signal from CPU port E (strobe data irrelevant), one output is selected from among seven inputs sent to the CPU input ports.

Thus, the four 7-to-1 multiplexer circuits of IC3 supply 4-bit outputs to the CPU input A ports from 28 inputs (in practice, 4 input terminals are fixed) and the remaining operation and sensor signals go directly to the input B ports.

At the same time, the four 7-bit latches of IC4 function as output expanders. The 4-bit outputs of the CPU D ports are expanded to 28 latched outputs. Latch positions are determined by the 3-bit bus select from the CPU E ports and the strobe data.

The following describes the overall operational flow.
If a given control key is depressed, a 10-bit serial code (operation code) corresponding to that mode is output by the function key code generator. The operation code is fed to IC2 after being amplified at IC1. IC2 is a serial-to-parallel decoder which converts the operation code of a 10-bit serial code into a parallel 8-bit signal. This parallel 8-bit signal is then input to multiplexer IC3 and then fed to IC5 (CPU). The CPU is capable of detecting which control key is depressed through this input data.

The CPU also detects other input port data. These include timer, cassette switch, cassette lamp and the various sensors. Data pertaining to the depressed key are checked, such as whether it is the same as the mode in progress and whether shift to a newly selected mode is possible from the present mode. Outputs corresponding to the operation key are then sent to the motors, solenoids and circuit boards.

From port D, the 4-bit output goes to IC4 latch, resulting in 28 latched outputs which are sent through open collector inverters to the circuit boards. Control signals also go to the operation board for lighting the LEDs corresponding to the depressed operation key.

Three bits of the four-bit port F output are for loading motor control. These are supplied via inverters to the control generator (consisting of four diodes) for determining motor torque and to electronic switches (Q5, Q6) which select motor direction.

For example, in the play mode, rotation is in the loading direction. When the loading mechanism begins operation and the unloading (UL) switch becomes off, the CPU detects the start of loading. At the end of loading, the after loading (AL) switch becomes on, at which time the CPU detects the end of loading and stops the loading motor. The unloading process is the opposite of this.

The 4-bit port H output is divided into 2 bits each. These go via inverters to the solenoid drive and hold amplifiers for switching the main and pinch solenoids on and off according to mode. The pinch solenoid is driven after completion of loading (AL switch on) during play and recording.

Moreover, the 4-bit output from output port D is used for controlling the cassette motor.

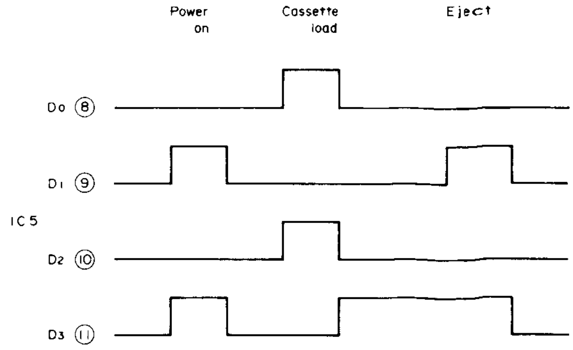


Fig. 3-1 Cassette motor control time chart

1. REEL MOTOR control

The reel motor is controlled by the output data of a total of 7 bits consisting of 3 bits of port C and 4 bits (pins 7 through 10) of the expander. The following is a brief summary of this control:

- ○ During FF/REW, a control voltage is supplied to the reel motor.
- ○ The output data controls the direction of the current fed to the reel motor.
- ○ Short REW/FF
- ○ The output data causes the current to flow in the reverse direction at the beginning of eject and during unloading. When the start sensor is ON, it will allow the motor to fast forward the tape for a short period until the leader tape passes.
- ○ The output data allows the voltage applied to the reel motor to gradually decrease when the counter reaches ±100 during the Counter Search mode.
- ○ Except during the search mode, the output data allows the control signal from the SERVO circuit board to be cut off.

1) When the FF or REWIND button is depressed (except during Search), pin-7 of expander IC4 becomes from High to Low. This causes pin-10 of IC12 to become High and a curved voltage determined by the charge of C4 will be fed to the base of Q17. And the voltage corresponding to that will be applied to E-SW.

2) The direction of the current applied to the reel motor is controlled by pins 2 and 3 of IC5. Normally pins 2 and 3 are High to turn on Q18 and Q19, thereby grounding both terminals of the reel motor.
When the reel motor is rotated in the fast forward direction, pin-3 becomes Low, thereby turning off Q13, Q11 and Q19. This allows the current output from the emitter of Q15 to flow in the following sequence: Q10 → CONN $\boxed{81}$ → reel motor → CONN $\boxed{82}$ → Q18 → ground, so that the reel motor is rotated in the fast forward direction.
When the reel motor is rotated in the rewind direction, pin-2 becomes Low, and unlike during fast forward, the current flows from CONN $\boxed{82}$ to CONN $\boxed{81}$. During the stop and brake of the reel motor, Q17 is designed to turn OFF so as to prevent any damage to E-SW due to overload.

3) IC 4 pin 10 and IC 5 pin 2 and 3 function to control the Short FF and the REW. When IC 4 pin 10 is high, the REEL MOTOR is rotated in the controlled direction by means of IC 5 pin 2 and 3.
The IC 4 pin 9 which is a control terminal of the IDLER becomes high when it transfers the IDLER.

4) When the counter becomes "0000" ± 100 at the time of SEARCH, IC 4 pin 8 is cut off and the TU REEL FG PULSE is impressed on IC 10 pin 7. Then IC 11 pin 10 becomes low because of periodic movement of the FG PULSE and since C4 discharges at this time, the voltage added to the Q17 base gradually decreases to the voltage inversely proportional to the TU REEL rotation, thereby preventing the overrun during the stop mode.

5) During the Search mode, the error voltage is supplied from the SERVO circuit board. This error voltage is controlled by whether a signal is fed to the base of Q17 from pin-5 of IC5 or not. Pin-5 of IC5 is normally High and becomes Low only during the Search mode.

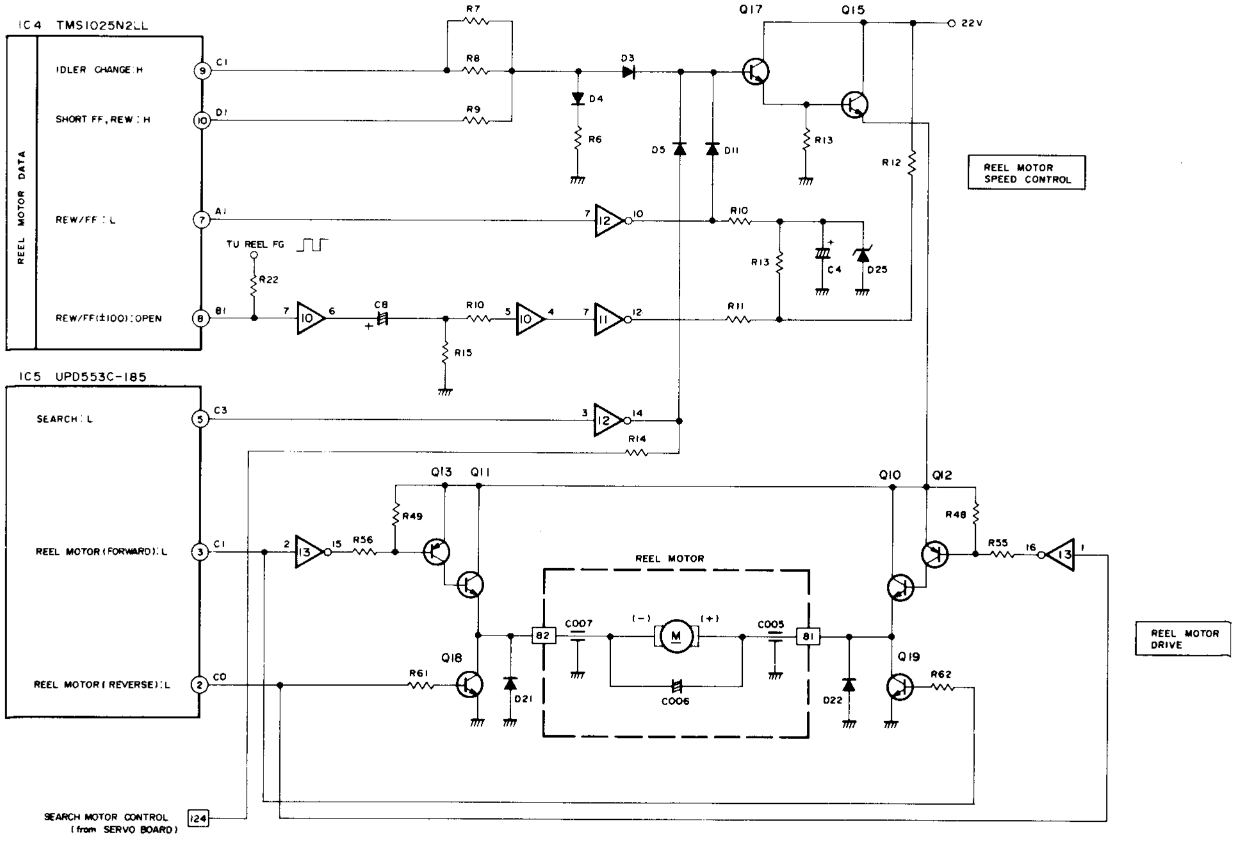

IC4 TMS1025N2LL
REEL MOTOR DATA
IDLER CHANGE : H
SHORT FF, REW : H
REW/FF : L
REW/FF(±100) : OPEN
9
10
7
8
C1
D1
A1
B1
R7
R8
R9
D3
D4
R6
D5
D11
TU REEL FG
R22
C8
R10
R15
R11
R13
C4
D25
R12
R14
Q17
Q15
22V
REEL MOTOR SPEED CONTROL
IC5 UPD553C-185
SEARCH : L
REEL MOTOR (FORWARD) : L
REEL MOTOR (REVERSE) : L
5
3
2
C3
C1
C0
Q13
Q11
R49
R56
Q18
R61
D21
REEL MOTOR
C007
(−)
(+)
M
C005
C006
82
81
D22
Q10
Q12
R48
R55
Q19
R62
REEL MOTOR DRIVE
SEARCH MOTOR CONTROL (from SERVO BOARD)
124

Fig. 3-2 Reel motor control circuit

2. POWER ON/OFF CONTROL CIRCUIT

A 10 bit serial code is used for power on/off control of the HR-7600. Since this functions does not appear in earlier models, a brief outline is given below.

The main control functions performed by this circuit are as follows.

1) Provided that the rear panel main power switch is on, this circuit operates when the front panel power switch is set from off to on.
2) When the front panel power switch is on, remote power switch operation becomes enabled.
3) After completion of loading, when the power switch is set to off, unloading is first performed, then the power is cut off.
4) If the power switch is set to off during the eject operation, the operation continues to completion, then the power becomes cut off.
5) Power on/off operation is inhibited while an operating button of the front panel or infrared remote control unit is pressed.

Front Panel Power Switch

When the power switch of the front operation board is set from off to on, Q1 switches on to short pins 8 and 9 of IC11 (M50115AP). The 10 bit serial code is sent from pin 17 to the mechacon circuit in approximately 25 msec.

Power on : 100 101 0000
Power off : 100 010 1000

This 10 bit serial code goes via mechacon board terminal 17 to the infrared receiver circuit at IC1 (M51014) pin 12. IC1 selects the signal from either the infrared remote control unit or the operation board and sends it to pin 16 of IC2 (M50127AP).

IC2 is a serial to parallel decoder and converts the 10 bit serial code to an 8 bit parallel code. Although the CPU controls the mainframe in accordance with these parallel data, power on/off is controlled by the flip-flop output from IC2 pin 11. After inverting at Q20, the flip-flop signal goes via connector 2 to connector 32 of the T/T board.

The power on signal is supplied to timer control CPU IC206 pin 35 and becomes obtained as a high level signal from pin 24. This signal goes through inverter IC208 pins 7 and 10, then via connector 43 to connector 53 of the power supply board. Low at connector 53 switches power on and high switches power off.

At the same time, the power on/off signal from the mechacon circuit is supplied via the servo board to connector 81 of the power supply board. The purpose of this is to maintain power in event the power switch is set to off while the eject or unloading mode is in progress.

If power is set to off during eject, high potential from IC5 pin 31 becomes inverted at IC12 pins 5 and 12 and goes as low from mechacon connector 127 to power supply board connector 81 to maintain the power on state. Thus, even though high appears at connector 53, the low at connector 81 maintains power on until the completion of eject.

Similarly, connector 81 potential maintains power on during loading until the loading arm reaches the completely stopped state.

During loading or play (loading complete) modes, the power switch off sends the 10 bit serial code to IC2 (M50127AP), which detects the power off state. Low from flip-flop output IC2 pin 11 goes through inverter Q20, and appears as a high level signal at IC3 pin 9.

From this high, the mechacon CPU detects the power switch off state and issues the stop mode instruction to the mainframe. The loading motor turns to begin unloading. While the loading arm is in the loading state, high appears at CPU IC5 pin 31. This signal maintains power on during loading and becomes low when the loading arm reaches the stop state.

Since the power switch is electronically controlled, observe the following points during service.

① Check for presence of the 10 bit serial code during power on/off operation. For example, if another switch is held depressed due to faulty front panel installation, the power switch becomes inoperative.

② Observe that mechacon IC2 pin 11 changes between low and high states with power on/off operation.

③ Check IC206 of the T/T board. Power on/off for both timer recording and normal operation is controlled by the same circuit via T/T board IC206. Therefore, it is important to check IC206 operation.

During service, inadvertently touching the clock oscillator (pins 1 and 42) by hand can stop the CPU operation. Even with the power cord disconnected, the approximately 10 minute period of the back up capacitor can prevent IC206 reset. Therefore, in this event, disconnect the power cord and short the leads of the back up capacitor.

④ Check CP-1 of the T/T board. This is an IC protector fuse which opens when current flow exceeds 1 A. Therefore, in event of a short occuring in the tuner/timer circuit, be sure to check CP-1.

3.1.2 Infrared remote control unit

As the operation control on the main unit duplicates that of the infrared remote control unit in principle, the description that is given centers on the infrared remote control unit.

Infrared remote control unit

The infrared remote control as adopted for the HR-7600 is a beam remote control using infrared rays whose wavelength is on the order of 950 mm.

The remote control transmitter uses an LED (near infrared light emitting diode) and the receiver (main unit) uses a photodiode. The remote control functions by intermittently emitting a frequency (40 kHz) with a certain pulse allocated for each function of the remote control.

The function of the remote control as used in the HR-7600 is described below:

1. Transmitter

The infrared rays which have been adopted for use can be referred to as near infrared rays with a wavelength of 940 nm and they show spectral characteristics of the LED used in the transmitter.

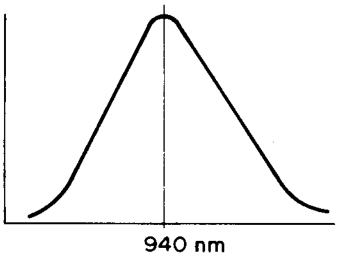


Fig. 3-3 Spectral characteristics of the LED used in the transmitter

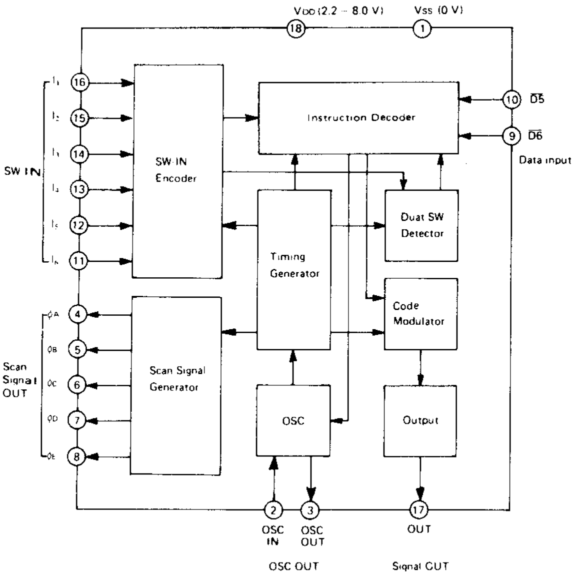


Fig. 3-4 Parallel to serial encoder (M50115AP)

The remote control transmitter employs a GaAs infrared light emitting diode.

The remote control transmitter consists of GaAs infrared light emitting diode and an IC (M50115AP) that generates the PCM signal.
The block diagram of this is shown in Fig. 3-4.

When a button on the remote control unit is pressed, a 10-bit serial code corresponding to its function is transmitted.
However, what is actually transmitted is an intermittent infrared ray signal in the form of a 10-bit pulse.

2. Transmitting signal

When a button on the remote control unit is pressed, a serial 10-bit code is emitted from the infrared LED.
This serial 10-bit code is a pulse signal generated from IC (M50115AP) inside the remote control unit. That is, when a button on the remote control unit is pressed, a 10-bit serial signal corresponding to the control function is automatically generated.

In the HR-7600, since the clock frequency of the IC on the remote control unit is set to 455 kHz, the carrier of the transmitting signal output from the IC is of 38 kHz.

That is, the output code of a 10-bit serial signal is PCM modulated. The high level of the transmitting signal is about 2.5 msec. Thus, 10 pulses of 38 kHz is a positive pulse of the transmitting signal.

Next, the distinguishing of the transmitting code (code corresponding to the control switch) between "0" and "1" is made by varying the pulse width of the transmitting signal.

As shown in Fig. 3-5 when the code is "0", the width of the transmission pulse is made about 1 msec. When the code is "1", the width is set at about 2 msec.
1 code (1 control code) of the transmission command consists of a 10-bit serial code or 11 pulses. Thus 1 period (1 control code) is transmitted within 24 msec. The transmission code of one word for a 10-bit serial control code is fed to the LED driver circuit which generates infrared rays. The first 3-bit part of the 10-bit serial code are used as a key code between the transmitter and receiver.

In the HR-7600, this key code is set to "1" "0" "0". From 4-bit onward to 10-bit, output is made corresponding to that of each control key.
For operation codes, refer to Table 3-1.

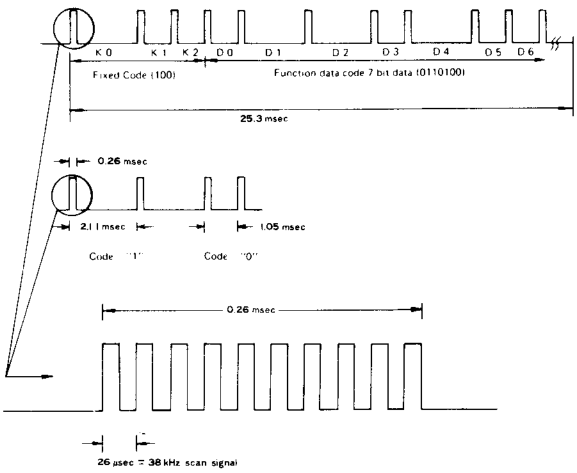

K 0
K 1
K 2
D 0
D 1
D 2
D 3
D 4
D 5
D 6
Fixed Code (100)
Function data code 7 bit data (0110100)
25.3 msec
0.26 msec
2.11 msec
1.05 msec
Code "1"
Code "0"
0.26 msec
26 μsec = 38 kHz scan signal

Fig. 3-5 Serial code

	D6	D5	D4	D3	D2	D1	D0
Stop	0	0	0	0	0	1	1
Power ON	0	0	0	0	1	0	1
F. F.	0	0	0	0	1	1	0
Rewind	0	0	0	0	1	1	1
Slow	0	0	0	1	0	0	0
X 2	0	0	0	1	0	0	1
Power OFF	0	0	0	1	0	1	0
Play	0	0	0	1	1	0	0
Pause/Still	0	0	0	1	1	0	1
Frame Advance	0	0	1	0	1	1	0
Channel Up	0	0	1	1	0	0	1
Audio Dub.	0	1	0	1	1	0	0
Rec.	1	1	0	1	1	0	0

Table 3-1

3. M50115AP

This M50115AP is a CMOS IC designed for the infrared remote control transmitter.
IC M50115AP consists of oscillating circuit, timing generator circuit, scan signal generating circuit, key-in encoder, instruction decoder and multiplex key decision circuit. This IC has a maximum of 6 x 5 key matrix inputs and 2-bit independent data inputs or a total of a 10-bit PCM (Pulse code modulation) code and is capable of transmitting a maximum of 124 sets of commands. Moreover, this IC stops oscillating except during key input (while a key is being depressed) to decrease power dissipation.

OSC circuit

Since this IC incorporates CMOS inverter and high ohmic resistors for biasing, connecting ceramic resonators to pins 2 and 3 forms an oscillating circuit.
By setting an oscillating frequency at 455 kHz, the carrier of the transmitting signal is made 38 kHz.
Also the oscillating circuit is disengaged except during key operation.

4. Infrared receiver

A 10-bit serial operation code by infrared rays transmitted from the remote control unit is received by the photodiode at the infrared ray receiving window situated to the right of center below of the operating panel on front of the HR-7600.
This photodiode is one specially made for the infrared remote control unit with a larger area than usual to be illuminated and having a higher sensitivity.
The spectral characteristics are shown in Fig. 3-6.

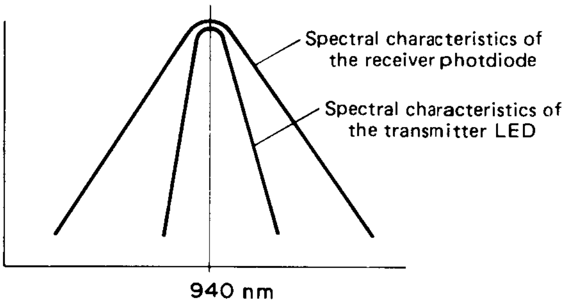


Fig. 3-6 Characteristics of infrared receiver

The transmission code corresponding to the operation key on the remote control unit is emitted in near infrared rays, which in turn is received by the photodiode installed on the MECHA-CON circuit board.
During infrared radiation, a minute current flows through the photodiode and an input signal voltage can be obtained corresponding to the rays (photoelectric conversion).

This input signal is amplified by pre-amp IC1 and passed through the filter (38 kHz or thereabouts) and the waveform-shaping circuit, and then fed to pin-16 of IC2 as a 10-bit serial PCM signal.

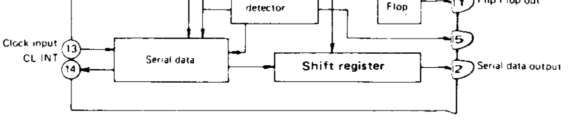

(4.5 – 8.0 V)
VDD
(0 V)
VSS
18
1
OSC IN
2
OSC DUT
3
OSC
Timing generator
Demodulator
Error prevention circuit
Output Circuit
AC
17
Auto Clear input
Auto clear
SI
16
input
Receiver
Receive code detector
Flip Flop
Clock input
13
CL INT
14
Serial data
Shift register
4
D0
5
D1
6
D2
7
D3
8
D4
9
D5
10
D6
11
Flip Flop out
15
2
Serial data output

Fig. 3-7 Serial to parallel decoder

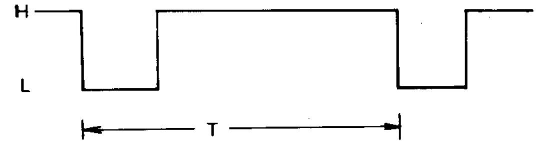
3.1.3 Serial-to-parallel decoder

In the HR-7600 when a Function button on the main unit is pressed, the information is encoded into the operation code (10-bit serial signal) by the function button code generator IC1 (M50115AP) on the operation PCB and fed to pin-12 of IC1 on the MECHA-CON circuit board. The signal amplified here is inputted to pin-16 of IC2 (M50127AP) serial-to-parallel decoder and fed to IC3 (TMS1025N2LL) input expander as an 8-bit parallel signal. Likewise, the signal from the wireless remote control unit is sent to IC2 and decoded into 8-bit parallel signal.

The serial-to-parallel decoder (M50127AP) is a specially manufactured IC for the infrared remote control receiving system and consists of oscillating circuit, timing generator circuit, demodulating circuit, malfunction prevention circuit, receiving state decision circuit, serial data processing circuit, shift register, receiving input circuit, and auto-clear circuit. This IC identifies the transmission signal from the receiver and is capable of remotely controlling 120 operations.

(1) Receiving input circuit and demodulating circuit

The operation code is inputted to $\overline{\text{SI}}$ and processed in the input circuit and then fed to the demodulating circuit, where the pulse width of the pulse signal is judged and the pulse signal is converted into the digital code. The relationship between the $\overline{\text{SI}}$ input waveform, code and data is shown in Fig. 3-8.



T between 0.4 msec and 1.6 msec yields code "0", data "L".
T between 1.6 msec and 3.2 msec yields code "1", data "H".

Fig. 3-8 Serial code demodulator

When the width of the input pulse of the $\overline{\text{SI}}$ input exceeds 3.2 msec., one word is judged to have terminated at this point. When the width goes beyond about 50 msec., the transmission command is judged to have finished and each output goes into a standby mode. In the standby mode, data output $D_0 \sim D_6$ and 1R become Low.

(2) Malfunction prevention circuit

The signal whose duration of "L" of $\overline{\text{SI}}$ input is below 50—100 μsec cannot be accepted as a transmission signal. Also when Tp or pulse width is below 0.4 msec., the unit re-enters the Standby mode to prevent any malfunction. Furthermore, when the input codes are all "0" or "1", the unit re-enters the Standby mode.

(3) Receiving state decision circuit

If the same transmission code is continuously received more than once, IR or the receiving state display output becomes High.

(4) Received code and data output

Data output $D_0 \sim D_6$ correspond with the transmission code $D_0 \sim D_6$. When the code is "0", the data output will be "L". When the code is "1", the data output will become "H". The FF or the output of the flip-flop will become "H" when the transmission code $D_0 \sim D_6$ is "1010000" and become "L" when the transmission code $D_0 \sim D_6$ is "0101000". In this unit, this code is allocated for ON/OFF of the power.

(5) Serial data processing circuit

After about 6.25 μsec. from the time when the same code is received twice (that is, when IR output goes from "L" to "H"), the input output goes from "L" to "H". If a clock pulse is inputted to CL or clock input for serial data output while the INT output is "H", the transmission code then received will be outputted to SD serial data output in the order of $D_0 \sim D_6$ synchronizing with the rise edge of CL input. Therefore, if the state of SD output is judged by the fall edge of the CL input, the content of the transmission code can be read. (Refer to the timing diagram.) The SD output is of a 3-state construction. During the Standby mode, it is disable (presenting a high impedance). After the INT output becomes "H", the disable state is released during the fall edge of the first CL input. After that, the serial data $D_0 \sim D_6$ is outputted. Once the INT output becomes "L", the SD output will be disable again. (The pull-down resistor is incorporated in the CL input.)

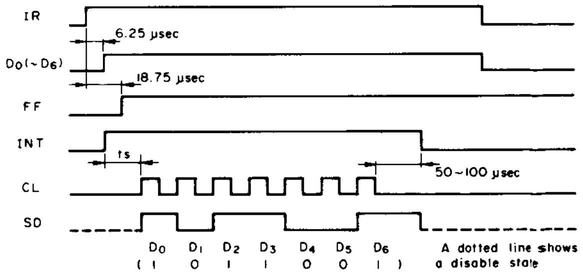


Fig. 3-9 Timing of senial to decorder

3.1.4 Tape-end detection function

A front-loading design has been adopted for the HR-7600, the cassette is enclosed inside the main unit so that the tape condition cannot be observed during recording and playback.

Therefore, in the HR-7600 when the tape nears its end during recording and playback and about 10 minutes of tape remains, a tape-end LED indicator on the left upper side of the front panel comes on and starts flickering 5 minutes before the end of the tape to inform the user that just less than 5 minutes of tape remains.

This function is referred to as the tape-end detection function. The detection of the tape-end is controlled by the microcomputer on the servo PWB.

The detection of the tape-end can be made by measuring the rotation time of the disks on the take-up and supply reel.

The reel disk as used in the HR-7600 comprises a combination of wheel with 48 teeth and a photo sensor; a single revolution of the wheel generates 48 pulses. By measuring the time for counting 48 pulses of both the take-up and supply reel disks, the time required for a revolution of each reel disk can be obtained.

By detecting the amount of time both reel disks to take for a single revolution, the type of the cassette can be determined: That is, either thick-hub reel (T20, T60) or a thin-hub reel (T90, T120). After the type of cassette has been determined, measuring the time required for a rotation of the supply reel disk allows the detection of the remaining tape.

NOTE: As the tape speed is constant, the following equation can be given:

(Number of pulses of supply reel FG)^2 + (Number of pulses of take-up reel FG)^2 = constant

Also, by seeking a mean value of the number of pulses of supply and take-up reels, the type of tape can be known.

3.1.5 Various operations by the mechanism controller

Here, various operations controlled by the mechanism controller are described.

1. POWER ON

Power ON means a condition where the sub-power indicator on the front panel is lighted. In this condition, all the operations including the loading/unloading of the cassette for the first time are possible.

The POWER-ON condition requires that the AC switch (on the rear panel) be turned ON and,

(1) Set the sub-power switch on the front panel to ON. When it is already set to ON, set it to either the OFF or TIMER position to clear once then set it to ON again. Or perform the power-on operation via the remote control unit.

(2) The sub-power switch is in the TIMER position and the timer reaches the preset time range.

The first operation after power is ON (the power-on in the Timer mode will be discussed later) is . . .

(1) When a cassette is not loaded in the HR-7600, the cassette housing motor rotates in the eject direction for 1—2 sec. then stops. The mode indicators will all be off.

(2) When a cassette is loaded in the HR-7600:
  1) The HR-7600 will go into the eject mode when the cassette does not press the cassette switch.
  2) When the cassette presses the cassette switch,
    a. When the tape is unloaded, the HR-7600 will go into the Stop mode after applying a low voltage to the cassette housing motor for about 1 sec. in the direction of IN.
    b. When the tape is not in the unloading state, the HR-7600 will go into the Unloading mode.

2. POWER OFF

Power OFF means a condition where the sub-power indicator on the front panel is not lighted. In this condition, all the operations including the loading/unloading of the cassette are impossible.

In order to turn off the power,

(1) Turn the MAINS POWER switch (on the rear panel) to OFF. In this case, even if the MAINS POWER switch is turned ON again, the HR-7600 will not turn on unless it is in the Timer mode. However, when the MAINS POWER switch is turned off for an extremely short period of time, the previous state will be maintained.

(2) Set the sub-power switch on the front panel to OFF. During loading, unloading and eject operations, power will be turned off after completion of the respective operation. (Loading will change to unloading.)

(3) When the program timer is not within the preset time range, set the sub-power switch to the TIMER position. When set to the TIMER position during recording (except in the Pause mode), the HR-7600 will go into the Sleep mode and continue recording and will not be turned off.

(4) Turn the power OFF via the remote control unit. During loading, unloading and eject operations, power will be turned off after completion of the respective operation.

3. General controls

For mode changes, refer to the mode change table.

Control operations on the main unit have priority over all operations on the remote control unit including power ON/OFF. The order of priority is 1) control operations on the main unit, 2) wireless remote control operations, and 3) wired remote control operations. The camera remote control operations will have the same in priority as button operations on the main unit. There is no order of priority among the control buttons; when two or more buttons are pressed simultaneously, their intended operation will become void. However, an exception is that the REC and AUDIO DUB buttons will be valid when they are pressed simultaneously with the PLAY or STILL/PAUSE button.

Control operations via the wired remote control unit have an order of priority:

When two or more are pressed at the same time the one having the highest priority will become valid.

4. Operations that are performed automatically

(1) Automatic STOP

1) When the tape is fully rewound in the rewind mode;
   - ○ When the leader portion of the tape is detected, the tape is wound in the forward direction until the leader portion passes the detector, then stopped.

2) When the tape counter reaches "0000" in the Counter Search mode with the mode set to FF or REW.
   - ○ In this case, the counter should read "0000" without fail in the Stop mode when an E-30 tape is used.

3) When the tape is fast-forwarded or rewound in the Cue Search mode;
   - ○ When the cue signal is detected, the automatic stop will be engaged.

4) When the tape is left for 5 to 7 minutes continously in the Still/Pause or Slow mode.

5) When the supply reel does not rotate within about 7 seconds in the Fast forward mode.

6) When the take-up reel does not rotate within about 7 seconds in the Rewind mode.

7) When the take-up reel does not rotate within about 2 seconds in the Play mode (does not apply to Still/Pause, Slow and Search modes).

8) When the drum does not rotate within about 3 seconds after the loading switch is ON.

9) When the tape loading has not finished within about 6 seconds after entering the Play mode.

10) When power to the video recorder is turned off.

(2) Automatic EJECT

1) When the end of the tape is reached in the Timer Record mode.

2) When the tape-end detection lamp is burned out.

3) When the cassette switch has not been pressed even after a cassette has been loaded for about 6 seconds.

4) When the beginning- and end-of-tape detection mechanisms are both turned on simultaneously (when light enters both).

5) When the cassette switch is turned off (by pressing) from the ON (position).

6) When a cassette with its tab removed is loaded in the Timer Recording mode.

(3) Automatic REWINDING

When the end of the tape is reached in all modes except the Timer mode.

(4) Automatic Still/Pause

In the Timer mode, when the timer has reached 10 seconds prior to the preset time for timer recording to begin.

(5) Automatic stopping of all drive mechanisms

1) When the unloading operation has not finished within about 6 seconds after entering the Unloading mode.
   - ○ In this case, the indicator continues flickering as previously engaged while all the drive mechanisms are stopped except the capstan motor and drum motor. At this point, all the controls will be disabled also.

2) When the eject operation has not finished within about 6 seconds after entering the Unloading mode.
   - ○ In this case, the EJECT indicator continues flickering whereas all the drive mechanisms are stopped. At this point, all the controls will be disabled also.

5. TIMER mode

(1) Basics regarding the Timer mode

1) When the video recorder is set to the Timer mode, all the controls will be disabled.

2) In principle, when the video recorder is in the timer mode it will enter the Recording mode at the preset time. However, when a cassette with its tab removed is used, the video recorder will enter the Eject mode when set to TIMER.

	STOP	PLAY	STILL/ PAUSE	SLOW	X 2	FRAME ADV.	S. FF	S. REW	FF	REW	REC PLAY	REC PAUSE	A. DUB PLAY	A. DUB PAUSE	PAUSE
STOP		O	X	X	X	X	X	X	O	O	O	O	O	O	O
PLAY	O		O	O	O	X	O	O	O (S. FF)	O (S. REW)	O	O	O	O	O
STILL	O	O		O	O	O	O	O	O (S. FF)	O (S. REW)	O	O	O	O	O
SLOW	O	O	O		O	X	O	O	O (S. FF)	O (S. REW)	O	O	O	O	O
X 2	O	O	O			X	O	O	O (S. FF)	O (S. REW)	O	O	O	O	O
S. FF	X (PLAY)	O	X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)	O	X (PLAY)		X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)
S. REW	X (PLAY)	O	X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY	X (PLAY)	O	X (PLAY)		X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)	X (PLAY)
FF	O	O	X	X	X	X	X	X		O	O	O	O	O	O
REW	O	O	X	X	X	X	X	X	O		O	O	O	O	O
REC PLAY	O		O REC PAUSE	X	X	X	X	X	X	X		O	X	X	X
REC PAUSE	O	O REC PLAY		X	X	X	X	X	X	X	O		X	X	X
A. DUB PLAY	O		O A. DUB PAUSE	X	X	X	X	X	X	X	O	O		O	X
A. DUB PAUSE	O	O A. DUB PAUSE		X	X	X	X	X	X	X	O	O	O		X
EJECT LOADING	O	O	X	X	X	X	X	X	O	O	O	O	O	O	
EJECT UN-LOADING	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Table 3-2 Mode shift table

3) The power will continuously be applied in the Timer mode as long as the program timer is within the range of preset time.
   - ○ Normally power is turned on 10 seconds prior to the preset time and the video recorder stands by in the Pause mode for 10 seconds. When the tape reaches its end, the video recorder will eject the cassette automatically. At this point if another cassette is loaded, the video recorder will automatically enter the Recording mode.

(2) The first operation after POWER ON

1) When a cassette is not loaded;
   - ○ The cassette housing motor rotates for 1 to 2 seconds in the direction of Eject, then stops. At this point, all the mode indicators will be off. In this state, if a cassette is loaded, the video recorder will automatically enter the Recording mode.

2) When a cassette is loaded;
   - i) When a cassette does not press the cassette switch; The video recorder will enter the Eject mode.
   - ii) When the cassette presses the cassette switch;
     - a) With the tape in the unloading state
       - ○ After a low voltage is applied to the cassette housing motor in the direction of IN for about 1 second, the video recorder will enter the REC-PAUSE mode.
     - b) With the tape not in the unloading state
       - ○ The VTR will go into the REC-PAUSE mode.
     - c) With the tape wound to its end
       - ○ This state supersedes a) and b) above, and the video recorder will enter the Eject mode.

6. Camera pause

(1) The camera pause is engaged only when the REC SELECT switch is set to the CAMERA position in the REC mode.

(2) When the pause operation is made initiated via the camera, the video recorder will go into the REC-PAUSE mode if operating in the REC mode. Once set to this state, no controls on the main unit will put the video recorder into the REC-PLAY mode again.

(3) When the REC-PLAY operation is entered from the REC-PAUSE mode via the main unit control, first set the camera's pause control switch to the PAUSE (STOP) position, then back to the PLAY (START) position in order to obtain full camera control over the video recorder.

(4) When the camera pause control switch is at the PLAY (START) position, the main unit controls will not be restricted at all.

3.1.6 Check points regarding the mechanism controls

1. POWER ON-1

   Make sure that the unit will not be turned ON even if the MAINS POWER switch on the rear panel is flipped from OFF to ON. Make sure that the sub-power indicator will not come on even if the on/off operation of the MAINS POWER switch is repeated 4 times with the sub-power switch on the front panel set to ON.

2. POWER ON-2

   Make sure that the POWER ON operation functions every time. Make sure that the sub-power indicator lights without fail every time the on/off operation of the sub-power switch is repeated 4 times with the MAINS POWER switch ON.

3. Initial operation

   Be sure that the cassette is positioned correctly after power is switched and the cassette is loaded.

   Without loading a cassette, but with the cassette switch pressed turn the unit on and off. At this point, make sure that the cassette housing motor rotates momentarily in the direction of loading.

4. Operation switches

   Make sure that each control switch operates without fail and that each indicator lights properly.

   Confirm by referring to the mode change table (Table 3-3).

5. Tape-end sensors

   Make certain that both the tape-end sensors operate without fail at both ends of the tape.

   Check it in the FF and REW modes.
   FF: Auto rewinding at the tape's end
   REW: Auto stop at the tape's end

6. Auto stop-1

   When the rotation of the reel stops in the either fast forward or rewind mode, the video recorder should enter the Stop mode automatically. Enter fast forward or Rewind without loading a cassette while pressing the cassette switch. Check if the video recorder automatically enters the Stop mode in about 7 seconds for both FF and REW modes respectively. At this point, be sure to cover both tape-end sensors.

7. Auto stop-2

   When the rotation of the take-up reel stops in the Play mode, the video recorder should enter the Stop mode automatically. Enter Play without loading a cassette while pressing the cassette switch. Check if the video recorder automatically enters the Stop mode in about 2 seconds when the rotation of the take-up reel is manually stopped after the loading operation has finished.

8. Auto stop-3

   When the rotation of the head drum stops in the Play mode, the video recorder should enter the Stop mode automatically.

   Enter Play without loading a cassette while pressing the cassette switch. At this point, check if the video recorder automatically enters the Stop mode when the rotation of the head drum is manually stopped, see if the Play mode is cleared in about 3 seconds and the head drum starts rotating when it is released.

9. Auto stop-4

   Make sure that the video recorder automatically enters the Stop mode in 5 to 7 minutes after being left in the Still mode.

10. Auto stop-5

    Make sure that the video recorder automatically enters the Stop mode at the detection of a cue signal when fast-forwarding or rewinding in the Cue-search mode. Check in both directions – FF and REW – using the cassette tape on which a cue signal has been recorded. Make sure that auto stop does not function when the Cue-search is OFF.

11. Auto stop-6

    The video recorder should automatically enter the Stop mode when the counter reaches "0000" while fast-forwarding or rewinding in the Counter-search mode. Make sure that the video recorder stops when the counter reads "0000" using an E-30 tape when the unit is made to enter the Rewind mode starting from a counter reading of 200 or more. Also make sure that auto stop does not function when the Counter-search is OFF.

12. Fast-forwarding and rewinding duration

    At normal temperature an E-180 tape should take less than 4 minutes 30 seconds to rewind. Calculate the duration after confirming that the video recorder is not in the Counter-search or Cue-search mode. Also it is not necessary to choose between fast forwarding and rewinding; either will do.

13. Detection of an unrecordable cassette

The video recorder should be able to properly detect if the loaded cassette is recordable or not.

Make sure that the video recorder does not enter the Recording mode with a cassette whose erasure prevention tab has been removed. Check that the VTR does enter the Recording mode when a cassette with its tab intact is used. At this point, check to see if the Recording mode is not cleared even if the area surrounding the SLOW button on the front control panel is pressed.

14. Tape counter

The tape counter should function properly.

Load the cassette, then check to see if the counter counts up in the FF mode and counts down in the REW mode.

15. Tape-end indicator

The tape-end indicator should function properly.

Using a pre-recprded tape, check to see if the tape-end indicator flickers when the tape nears its end.

16. Remote control operation

Button controls on the main unit have priority over those on the remote control unit.

First press the FF button on the remote control unit (the video recorder enters the FF mode). Make sure that the video recorder enters only the Rewind mode while the REW button on the main unit is being pressed and while keeping the FF button on the remote control unit pressed.

17. Timer operation-1

Make sure that with the program timer the video recorder enters the REC-PAUSE mode 10 seconds prior to the preset interval of time, and goes into the recording mode when the timer reaches the preset time.

18. Camera Pause

Make sure that the switching operation between the REC and REC-PAUSE mode with the camera connector functions properly when set to the REC mode.

19. Wired remote control

Make sure that the wired remote control functions properly when connected to the wired remote control jack on the rear panel.

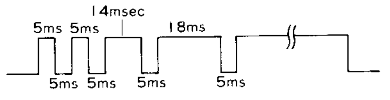
20. Remote control sensitivity

Directly-in-front operation .... Approx. 15 m
±30°-to-either-side operation ..... Approx. 10 m
±45°-to-either-side operation ..... Approx. 3 m

Measure the distance by directing the transmitter towards the main unit with nothing within a 2 m vicinity of the video recorder. At this point, care should be taken so that no strong light source such as fluorescent lamp, etc. is directed toward the main unit.

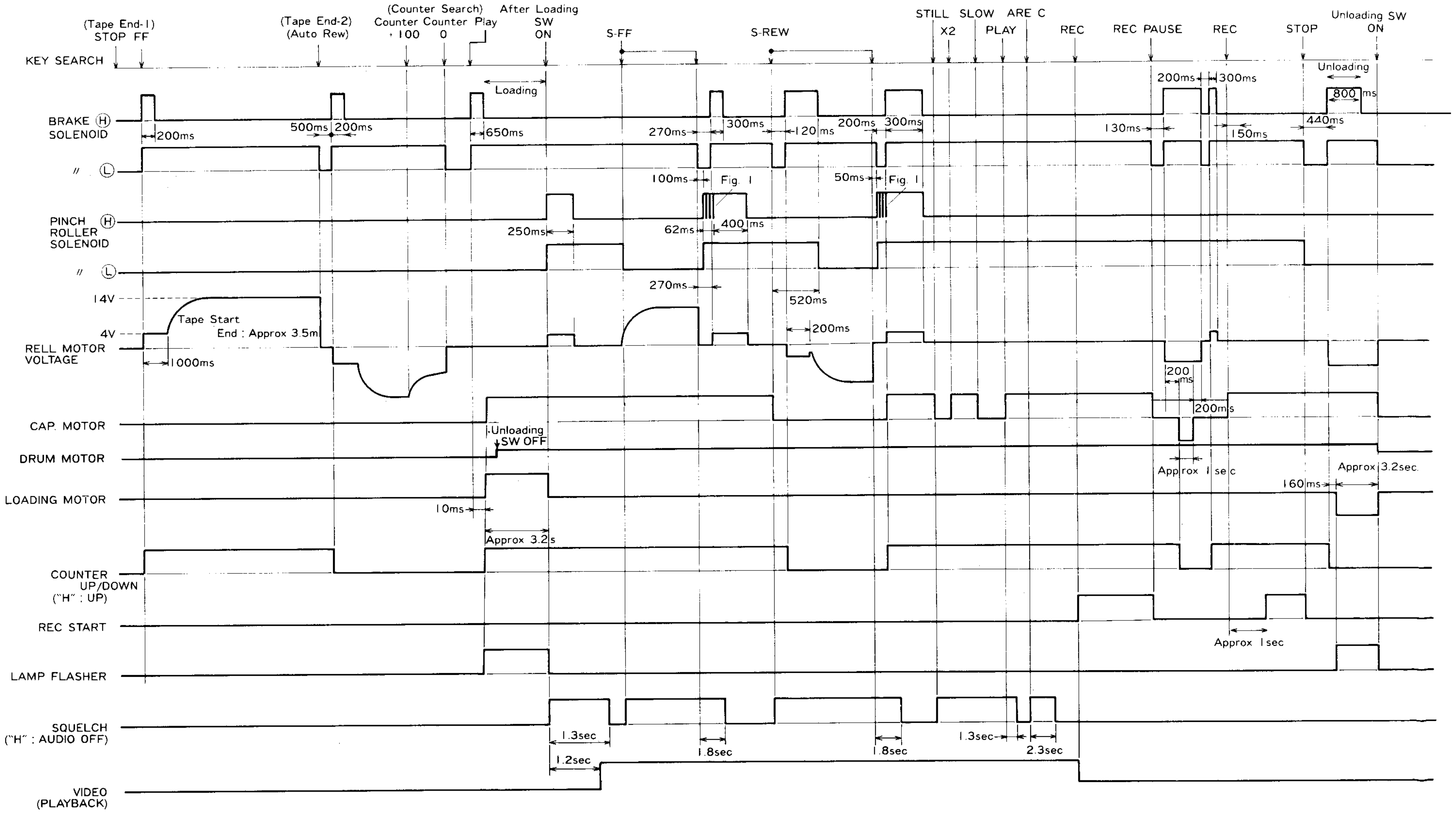
21. Error in the tape-end indication

Make sure that the error in the tape-end indicattion is within −30 seconds to +300 seconds.



14msec
5ms
5ms
18ms
5ms
5ms
5ms
5ms

Fig. 1



(Tape End-1)
STOP FF
(Tape End-2)
(Auto Rew)
(Counter Search)
Counter Counter Play
·100 0
After Loading
SW
ON
S-FF
S-REW
STILL
X2
SLOW
PLAY
ARE C
REC
REC PAUSE
REC
STOP
Unloading SW
ON
KEY SEARCH
Unloading
Loading
BRAKE Ⓗ
SOLENOID
〃 Ⓛ
200ms
500ms
200ms
650ms
270ms
300ms
120ms
200ms
300ms
130ms
200ms
300ms
150ms
800ms
440ms
100ms
Fig. 1
50ms
Fig. 1
PINCH Ⓗ
ROLLER
SOLENOID
〃 Ⓛ
250ms
62ms
400ms
270ms
520ms
14V
4V
Tape Start
End : Approx 3.5m
RELL MOTOR
VOLTAGE
1000ms
200ms
200ms
CAP. MOTOR
200ms
Unloading
SW OFF
DRUM MOTOR
Approx 1 sec
Approx 3.2sec
160ms
LOADING MOTOR
10ms
Approx 3.2s
COUNTER
UP/DOWN
("H" : UP)
REC START
Approx 1sec
LAMP FLASHER
SQUELCH
("H" : AUDIO OFF)
1.3sec
1.2sec
1.8sec
1.8sec
1.3sec
2.3sec
VIDEO
(PLAYBACK)

Fig. 3-10 Mechacon circuits timing chart

3.2 SERVO CIRCUIT

3.2.1 General description

In the context by which they are used in video tape recording equipment, servos can be defined as systems for automatically controlling mechanical quantities, such as rotational speed and phase, by detecting errors from the normal values and converting the error values into compensating feedback signals.

For servo systems are used in this model: 1) drum servo, which controls the speed and phase of the rotating video heads, 2) capstan servo, for controlling tape transport speed and phase, 3) reel servo, which controls the tape speed during search FF and search REW operation, and 4) back tension servo, for regulating tape back tension. Of these, the back tension servo operation is entirely mechanical. Therefore, only the drum, capstan and reel servo systems are outlined in this section.

Precision control is required for the drum and capstan systems, necessitating servo control of both speed and phase. Such high precision is not required during search FF/REW and thus only speed control is performed by the reel servo system.

Speed servo detects the speed error of the object (motor, etc.) to be controlled and converts the error value into a feedback signal. Phase servo requires a reference signal. The phases of the reference signal and the object to be controlled are compared to yield the error value, which is then used for feedback. Thus, when analyzing servo systems, it is necessary to first determine the reference and comparison signals for each operating mode.

Since the reel servo operates only during search FF/REW, the following description is centered on the drum and capstan servo systems.

3.2.2 Drum servo circuit

1. Purpose

The drum servo circuit controls the speed and phase of the head drum during recording and playback. Two control circuits are used independently for control of speed and phase.

Speed control circuit (discriminator):

Utilizing the FG signal produced by the drum motor, this circuit detects speed and compensates for variations.

Phase control circuit:

Utilizing the drum pulse produced by the magnet which is attached to the rotor of the motor, this circuit detects the phase of the rotating drum and corrects it. During recording, it detects the vertical sync signal of the video signal to be recorded and the phase of the drum pulse, thereby controlling the rotating phase of the head drum. In this way, the position of the video signal on the tape is controlled. During playback, the playback picture is stabilized by the head drum whose rotation is locked to the frequency of a quartz oscillator.

Table 3-3 summarizes the reference and comparison signals for controlling the speed and phase of the rotating head drum during recording and playback.

2. Signal flow during recording

1) Reference signal

The reference signal is taken from the vertical synchronization (V. sync) component of the video signal to be recorded. Composite sync from the Y & PRE/REC board is applied via connector 31 to a lowpass filter (LPF), which passes only the vertical sync component. At IC7 pin 23, a monostable multivibrator counts the signal down to 25 (30) Hz for triggering the next stage recording phase monostable. The output of the REC phase monostable then goes as the sampling signal to the sample & hold circuit.

MODE	DRUM SERVO		CAPSTAN SERVO	
	REFERENCE	COMPARISON	REFERENCE	COMPARISON
REC	VIDEO V. SYNC	DRUM PICK-UP PULSE	X'TAL OSC.	CAP. FG
PLAY BACK	X'TAL OSC		X'TAL OSC.	CONTROL PULSE
ASSEMBLY EDIT	VIDEO V. SYNC		VIDEO V. SYNC	CONTROL PULSE ↓ CAP. FG
INSERT EDIT	VIDEO V. SYNC		VIDEO V. SYNC	CONTROL PULSE
SEARCH	DISCRIMINATOR			
SLOW	X'TAL OSC	DRUM PICK-UP PULSE	PULSE DRIVE	

Table 3-3 Servo signal

The time constant of the REC phase monostable determines the position for recording the vertical sync signal on the tape. During recording, R73 adjusts the video head switching position.

2) Comparison signal

The comparison signal is obtained from the drum pulse, which corresponds to the video head rotational phase. Two magnets are embedded in the rotor of the drum motor and, as the drum rotates, a pickup head detects the magnets and produces the drum pulse.

R56 adjusts the level of the drum pulse supplied to pin 3 of IC7. The switching phase monostable compensates for small errors between the mounting positions of the magnets and video heads.

In the CCIR setting, the 70° delay monostable delays the signal by the angle difference with respect to the NTSC (30 Hz) setting.

The compensated drum pulse is converted into a squarewave with a 50% duty cycle by a flipflop circuit, then sent via the trapezoid circuit to the sample & hold circuit.

3) Phase error

At the sample & hold circuit, the phases of the reference signal from the recording phase monostable and the comparison signal from the trapezoid circuit are compared, yielding an error voltage which is held by C40. The error voltage goes from IC7 pin 14 to the loop filter and limiter. The loop filter serves to attenuate high frequency components in the error voltage, thereby avoiding irregular motor rotation and jitter. The limiter suppresses the error voltage to within a certain range to prevent abnormal rotation of the drum motor.

From the loop filter, the error voltage is sent through a voltage-follower to the non-invert input of the mixer. A DC voltage proportional to the error voltage is then obtained from the mixer output.

The error voltage from the discriminator circuit is applied to the invert input of the mixer. However, during recording, the drum motor rotation is essentially fixed, and thus the potential at the non-invert input can be considered fixed.

The mixer output is supplied to pin 1 of IC14, which controls drum motor rotation. Via pin 1, the error voltage goes through the input gain control, rectifier and control amplifier to the rotation control circuit.

At the rotation control circuit, the switching pulse from the Hall circuit is applied to pins 4, 5, 16 and 17. This pulse is used for controlling the direction of current flow in the motor coils.

4) Motor construction

As shown in Fig. 3-11, the motor is composed of an outer rotor and a stationary coil wound stator. Current flow in the coils produces a rotating magnetic field, which drives the rotor. Hall elements detect the rotor position and regulate the current flow in the coils, and consequently the rotational speed. This system is also capable of applying reverse (braking) torque, thus reducing the time needed to attain synchronous rotation.

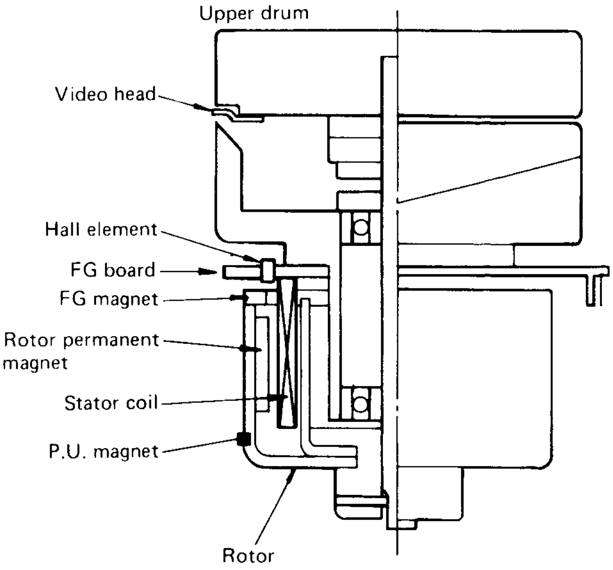


Fig. 3-11 Drum assembly

Hall element

In certain semiconductors, when a current (IC) flows perpendicular to a magnetic flux (b), a voltage (VH) becomes produced that is perpendicular (3 dimensionnally) to both the current and the magnetic flux. This relationship can be expressed as follows.

$$VH = RH \times \frac{IC \times B}{d}$$

In the above, RH is the Hall coefficient and d is the material thickness.

R_H : material constant (Hall coefficient)

d : conductor thickness

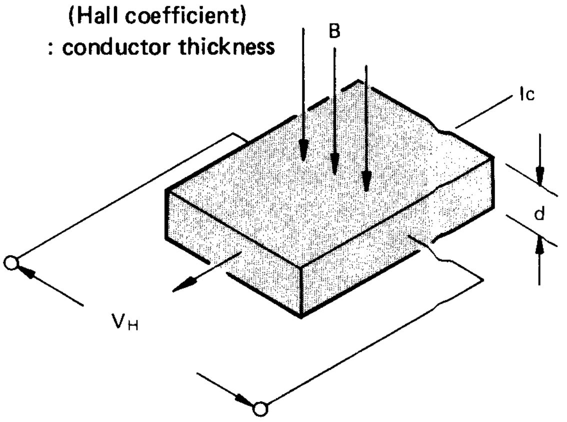


Fig. 3-12 Hall element

5) Motor circuit description
IC14 is illustrated in Fig. 3-13.

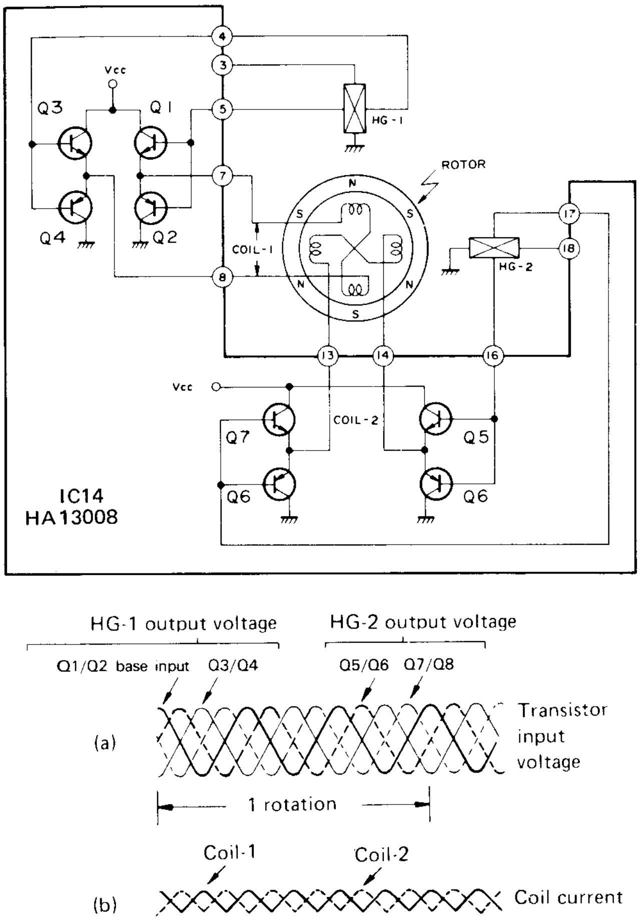


Fig. 3-13 Basic operating principle

Coils 1 & 2 and Hall elements HG1 and HG2 are mounted in the stator in the relationships indicated in Fig. 3-12. In the rotor, magnets are mounted with N and S poles alternating every 60°. As the rotor turns, the Hall elements detect the relative positions between the magnets and coils.

In the Fig. 3-13 example, a rotor N pole is adjacent to HG1, producing a positive voltage at the left output and a negative voltage at the right output of the Hall element. Q1 and Q4 switch on, while Q2 and Q3 switch off. Current from Vcc then flows in Q1, Coil-1 and Q4, and the rotor turns clockwise from the magnetic field produced in Coil-1.

As the N pole recedes from HG1, the voltage of HG1 ceases. But as the rotor rotation nears 60°, the S pole approaches HG2 and a positive voltage appears at the upper terminals and a negative voltage at the lower terminal of HG2. Q7 and Q6 switch on, and current flows from Vcc to Q7, Coil-2 and Q6. The rotor continues to turn from Coil-2 magnetic field. When an S pole reaches HG1, Q2 and Q3 switch on. Current flows in the opposite direction through Coil-1 and clockwise rotation continues. In this manner, sequential switching is performed and the rotor turns continuously in a fixed direction.

Speed and phase are controlled by voltages from the speed and phase servo circuits combined with Vcc. Switches are provided between the Hall elements and transistors that can apply the voltages from the Hall elements oppositely, producing a braking effect as current flows in reverse direction in the coils.

6) Drum speed control
Drum motor control signal from the mechanism board goes via connector 7 of the SERVO and D31 to IC14 pin 20. Low voltage (less than 2 V) is supplied to pin 20 of IC14 and the drum motor does not rotates. The motor current is proportional to the input voltage. High voltage (more than 7 V) is supplied to pin 20 of IC14 and the drum motor rotates.

The rotation of the drum motor automatically changes from forward to reverse, when the input voltage from IC14 pin 1 exceeds 5 V.

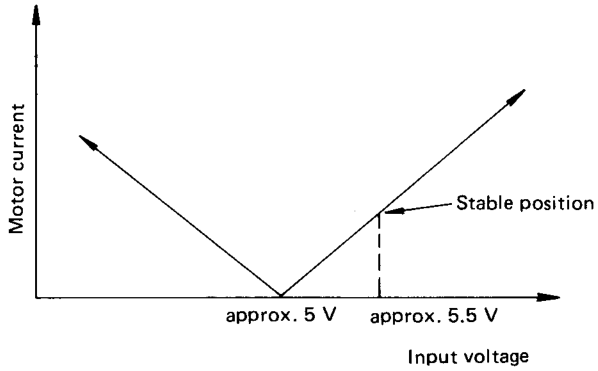


Fig. 3-14

7) Control signal
The reference signal from the 1/2 countdown monostable goes through the control delay and control duty monostables, which determine the interval between positive and negative pulses of the control signal for recording on the tape. This signal is then routed from IC7 pin 18 via the relay board to the control board.

2. Playback signal flow
An internal crystal oscillator signal is employed as the drum servo reference, while the comparison signal is the same drum pulse used for recording. The 32.768 kHz crystal oscillator frequency is counted down to 25 (30) Hz and triggers the recording phase monostable. Afterwards, signal flow is the same as during recording.

3. Speed control signal
The speed control (or discriminator) control system functions to maintain a fixed frequency during motor start-up (when frequency variation is large) and provide a dampling effect for reducing rotational irregularities. Motor rotation yields the frequency generator pulse, variations of which are converted into voltage variations, and these in turn are used for controlling motor rotation.

The FG pulse goes to the drum FG amplifier, a Schmitt circuit for shaping the waveform, then to the F-V (frequency to voltage) converter. With respect to the normal

FG frequency of 1600 (1920) Hz, an increase or decrease in frequency becomes converted into an increase or decrease in voltage.

This voltage is applied to an active filter for removing jitter, then to the invert input of the mixer. The mixer circuit amplifies and inverts the voltage, after which it is sent to IC14 pin 1. In this manner, drum motor rotation is controlled in order to yield an FG pulse frequency of 1600 (1920) Hz.

4. Search Fast Forward/Rewind

   The search mode is enabled only during normal playback while the desired FF or REW button is held depressed. In this mode, the tape is transported at approximately 9 (7) times normal playback speed.

   As indicated in Fig. 3-14, each video head traces 9 (7) recorded tracks. However, due to the slant azimuth recording system, each (CH-1 or CH-2) head produces an effective signal output only when it traces its corresponding track. Also, since the tracing angle differs greatly from normal speed, the playback FM waveform becomes a diamond-shaped pattern, as shown in Fig. 3-14, and noise bars appear in the picture display.

   In the search mode, the head to tape relative speed changes and the resulting deviation in the horizontal sync frequency could disturb horizontal stability in the playback picture display. Since the color signal also becomes unstable, compensation is performed by changing the drum rotation rate.

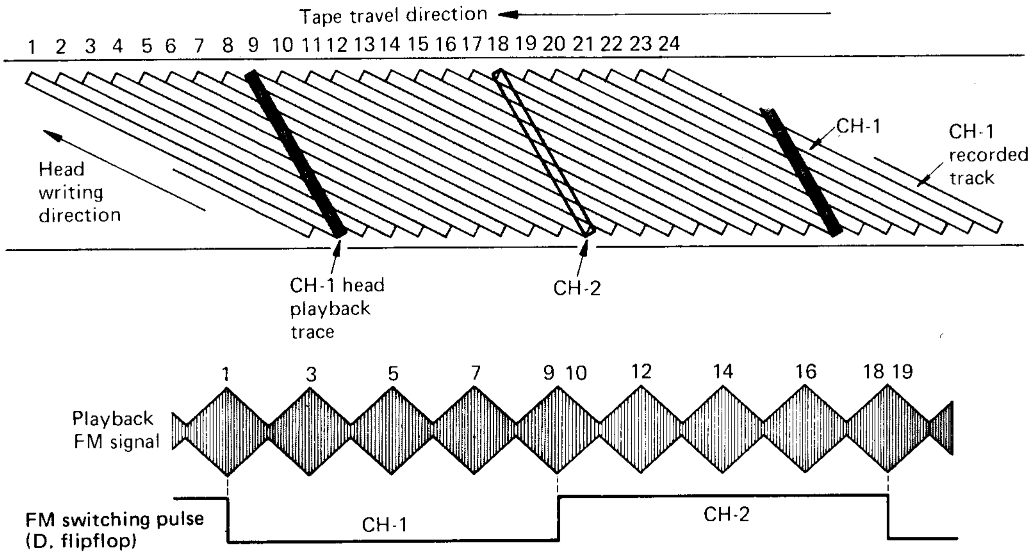
   Q6 switches on during search FF. The potential at IC13 pin 2 drops slightly, raising the potential at pin 1 from approximately 6 V to 6.4 V.

   Conversely, Q12 switches on during search REW, slightly raising the potential at IC13 pin 2, while the potential at pin 2 drops from 6 V to approximately 5.4 V.
   The error voltage output from IC13 pin 1 goes via an LPF and limiter, which suppress fluctuations, to electronic switch IC12. During the search mode, this switches from the phase error voltage to the horizontal discriminator error voltage.

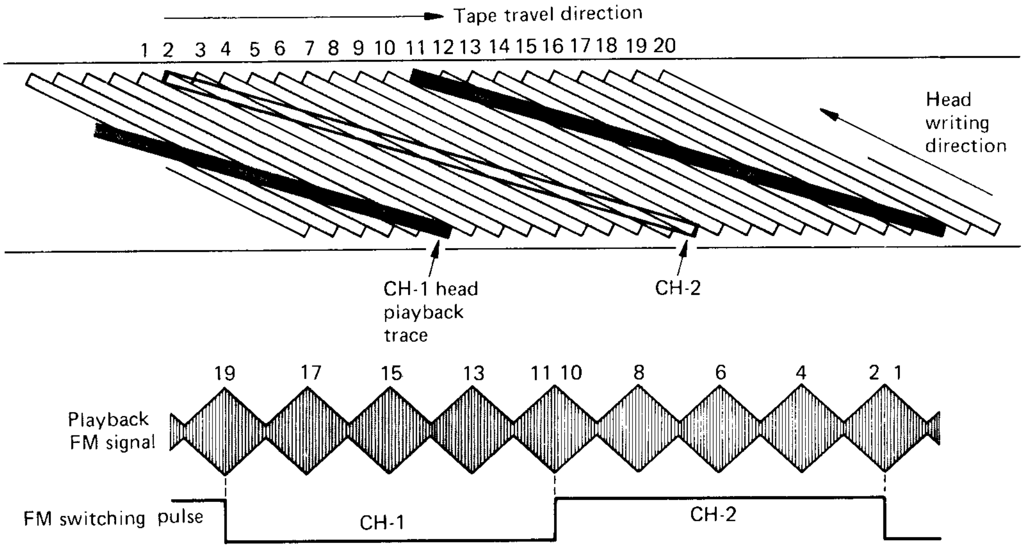
   From IC12 pin 8, the error voltage is sent in the same route as the phase error voltage and controls the drum motor.

5. Slow mode

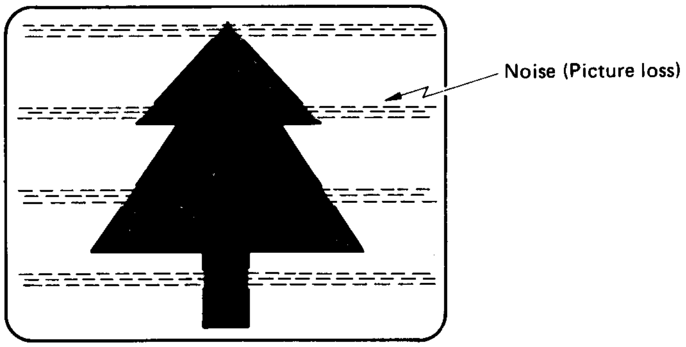
   In the slow mode, a fixed width pulse is obtained from IC6 pin 25 during the capstan motor start-up period. The pulse goes through D45 and R120 to IC13 pin 12. In this manner, compensation is performed for the deviation in relative head to tape speed during the capstan motor start-up period.


Tape travel direction
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Head writing direction
CH-1
CH-1 recorded track
CH-1 head playback trace
CH-2
1 3 5 7 9 10 12 14 16 18 19
Playback FM signal
FM switching pulse (D. flipflop)
CH-1
CH-2

(a) Search FF mode


Tape travel direction
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20
Head writing direction
CH-1 head playback trace
CH-2
19 17 15 13 11 10 8 6 4 2 1
Playback FM signal
FM switching pulse
CH-1
CH-2

(b) Search REW mode


Noise (Picture loss)

(c) Playback picture in Search FF/REW mode

Fig. 3-15 Search FF/REW pattern trace and playback picture

3.2.3 Capstan servo circuit

The capstan servo circuit functions to regulate the tape transport speed in order for the video heads to accurately trace the recorded signal tracks. Both speed and phase controls are employed.

1. Phase control system

The phases of the reference and comparison signals are compared to yield an error voltage which is employed for controlling the phase of motor rotation.

During recording, the FG pulse obtained from capstan flywheel rotation is divided to 25 (30) Hz and used for detecting the rotational phase of the capstan. Phase control is performed by comparing this with the phase of the 25 (30) Hz signal divided from the crystal oscillator frequency.

In the playback mode, the control signal picked up from the tape is employed. This is compared with the crystal oscillator signal and used for compensating deviations of the video heads from the recorded tracks.

2. Signal flow during recording

1) Reference signal

The reference signal is obtained from a 32,768 Hz crystal oscillator. This is counted down to 25 (30) Hz in IC7 and triggers the preset monostable, which determines the head tracing position during recording. From this circuit, the signal triggers the tracking monostable, which determines the time constant. The user-adjustable TRACKING control compensates for minor differences between prerecorded tapes during playback.

Raise and fall positions of the trapezoidal waveform are adjusted by the trapezoid duty monostable. This output goes through an inverter to the trapezoid circuit. The resulting reference signal is applied to the sample and hold circuit.

2) Comparison signal

The capstan FG pulse is employed for the comparison signal. This is sent via the relay board to servo board connectors 51 and 52. Following the AG amplifier and waveform shaping by the Schmitt circuit, the signal is counted down to 25 (30) Hz in IC7. This goes to the monostable and pulse generator circuits, then as the comparison signal to the sample and hold circuit.

3) Phase error

C27 holds the output from the sample and hold circuit, which varies in voltage with variation in phase. This is then obtained from IC7 pin 33 as the phase error voltage. In the same manner as the drum servo system, the error voltage goes through a loop filter, electronic switch and voltage follower to the non-invert input of the mixer.

At this point, the speed and phase error voltages are mixed and amplified. The mixer output is sent via an emitter-follower, which converts the impedance, and power amplifier to pins 2 and 8 of IC5. This is an interface IC which allows microprocessor control of the capstan motor forward, reverse and braking functions.

Switches SW1 and SW2 operate so that the capstan motor rotates at the speed and phase corresponding to the voltage at pin 2.

3. Playback signal flow

The reference signal is taken from the 32,768 kHz crystal oscillator and divided to 25 (30) Hz as during recording. At this time, the comparison signal is derived from the control signal played back from the tape.

From the control head, the signal goes via the relay board to the control pulse amplifier. A Schmitt circuit shapes the waveform, which is sent to IC7 pin 24, where it is inverted and triggers the control duty monostable. This output is converted to the sampling pulse by the monostable and pulse generator circuits, then supplied to the sample and hold circuit.

Afterwards, the signal path is the same as for recording.

4. Speed control signal

The FG signal obtained from capstan flywheel rotation is routed through the capstan FG amplifier, Schmitt circuit and IC7 (pins 25 and 26) to the F-V converter. In this circuit, variations in the pulse frequency are converted into variations in voltage.

During normal capstan motor rotation, the FG pulse frequency is 252.5 (360) Hz. Increase in the rotation rate yields a higher FG pulse frequency and the voltage rises. Conversely, reduced rotation produces reductions of both frequency and voltage. This error voltage output is sent to the invert input of the mixer.

3.2.4 Reel servo

The reel servo circuit controls reel motor rotation in order to regulate the tape speed during the search FF and search REW modes. In these modes, the tape is transported at 9 times (PAL & SECAM) or 7 times (NTSC) the normal playback rate.

The control head picks up the recorded control signal from the tape, which then goes via the relay board to servo board connector 41. The signal is routed through the control pulse amplifier and Schmitt circuits to IC7 pin 24. From IC7 pin 26, the control pulse is applied to the F-V converter, which yields a voltage variation corresponding to the frequency variation.

Q10 and Q11 switch on during search, increasing the amount of feedback and setting the F-V function for reel servo operation. The F-V converter output is inverted and amplified, then sent through a lowpass filter to yield the DC component from connector 24.

For subsequent operation, refer to the mechacon circuit description.

3.2.5 HR-7600 editing functions

This model includes both insert and assembly editing capabilities. A back space system is employed for both the HR-7600 whereby an approximately 1 second segment of the tape becomes automatically rewound after the PAUSE button is pressed in the editing mode.

In models without this feature, the tape simply stops at the point the PAUSE button is pressed. The recording servo disruption at this point results in a visible disturbance in the picture during playback. The back space system avoids this problem by allowing time for servo synchronization to be obtained prior to the editing point.

1) The HR-7600 is capable of both assembly and insert editing.
2) Tape rewind is performed by reversing the capstan motor.
3) The capstan frequency generator (FG) pulse is used for detecting the amount of tape rewind.
4) The overlapped segment at the edit start point is used for 5 frames.

	Assembly edit	Insert edit
Edit system	Back space edit	Back space edit
Back space	Capstan FG	Capstan FG
Back space condition	Reverse mode	Reverse mode
Double recording	First 5 frames	All insert REC
Full erase head	ON	OFF
Audio erase head	ON	ON
Audio head	ON	ON
Video head	REC Normal bias	REC 2.5 dB up
Control head	P.B. (20[25] frames) → REC	P.B.*
Capstan servo	P.B. → REC	P.B. (EXT. Lock)
Drum servo	REC	REC
Video	REC	REC
Audio	REC	Audio dubbing

Table 3-4 Assembly, insert control

* During insert editing mode, if the control signal is absent for more than 2 pulses, the recorder switches to the Rec. mode. At this time, if the control signal returns, the recorder maintains the Rec. mode.

1. Assembly editing
When the PAUSE button is pressed in the recording mode, the HR-7600 automatically enters the assembly editing mode. Picture recording stops, and the capstan motor and tape transport stop.

The capstan motor then rotates in reverse, while the CPU of the mechacon circuit counts the 25 (30) Hz capstan FG pulse. Thus, the tape travels for 1 second or 30 FG pulses (i.e., 25 [30] video frames) in reverse, after which the pause mode is entered.

At this time, by pressing the PLAY button, the play mode is first entered, during which 20 (25) capstan FG pulses are played back, then the recording mode is returned. Consequently, 5 frames become recorded overlapped.

During the 20 (25) frames playback, synchronization is established between the input video signal and the recorded control signal, thereby avoiding sync disturbance at the editing point.

The timing chart of the assembly editing is shown in Fig. 3-17.

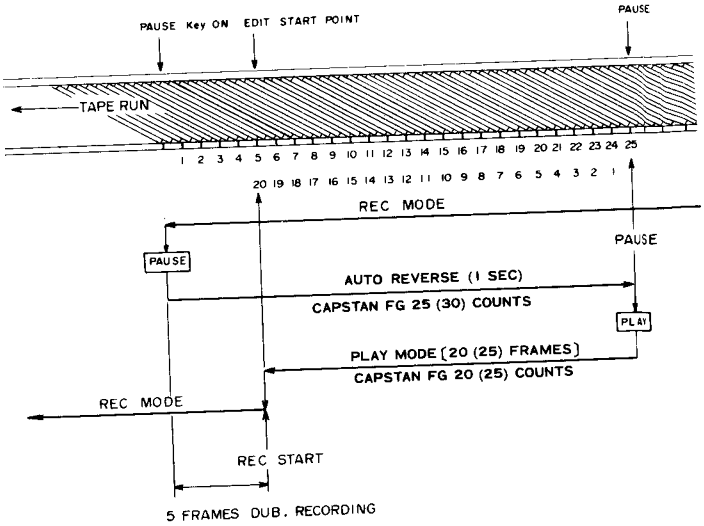


Fig. 3-16 Assembly editing

2. Insert editing
The insert editing function is basically the same as assembly editing. When the insert mode is entered, 25 (30) frames of the tape are rewound, 20 (25) frames played back, then only the video and audio heads perform recording.

① Insert editing uses a back space system.
② The capstan rotates in reverse for one second, while the 25 (30) Hz capstan FG pulse is counted (i.e., to count of 25 [30]) for controlling the back space amount.
③ In the insert editing process, 20 (25) frames are played back from the pause point, then the recording mode is entered.

④ Insert editing is performed simultaneously for the audio and video signals. It cannot be performed independently with this mode.

⑤ The audio circuit assumes the audio dub mode during insert editing. In the case of stereo versions:
Audio Channel 1 becomes set to playback.
Audio Channel 2 becomes set to recording.

⑥ The editing (recording) start point is 5 frames prior to the point the PAUSE button was pressed. The end point is at tape counter 0000 or when the STOP button is pressed.

⑦ The playback TRACKING control functions during insert editing. Insert editing can also be performed for tapes recorded on other (VHS format) machines.

⑧ During insert editing, if the control signal of the tape ceases, control signal recording automatically starts. However, even if the recorded control signal should return, this recording mode continues until completion of insert editing.

⑨ Video recording bias is increased by about 2.5 dB during insert editing.

- Insert editing allows the addition of new video and audio information to a previously recorded tape. Its main differences with respect to assembly editing are as follows.

① Only video recording is performed and the full erase head does not operate.

② When recording is performed, the servo system becomes synchronized to the control signal previously recorded on the tape.

③ The capstan servo circuit is in the playback status and synchronized externally (to the input video signal).

④ Sync disturbance is avoided at the editing start and end points.

If the tape control signal ceases, this model automatically switches to an internally generated control signal. Recording of this internal signal begins 2 frames after cessation of the tape control signal.
Afterwards, even if the tape control signal returns, it becomes disregarded and editing proceeds using the internal signal until the stop button is pushed or the tape counter reaches 0000. (See Fig. 3-18 and Fig. 3-19.)

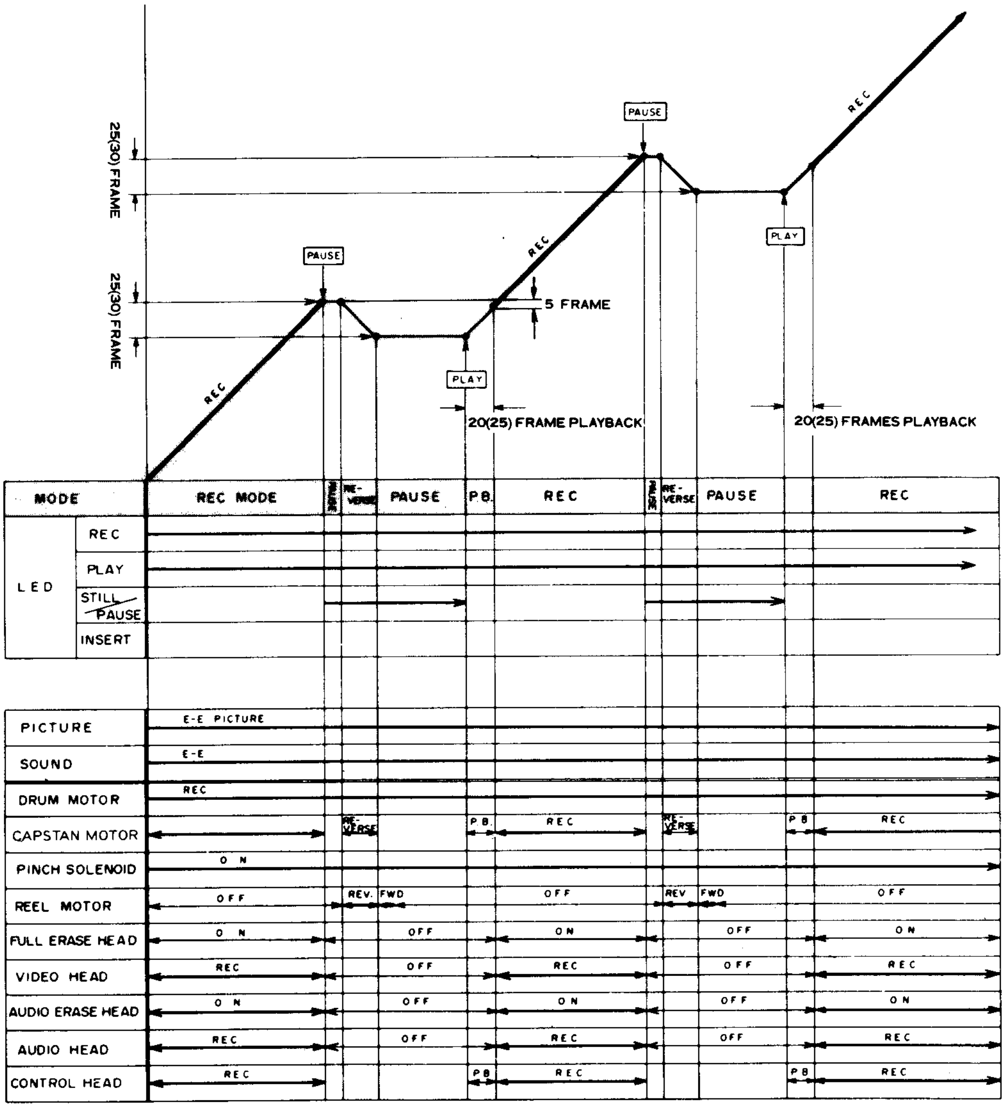

25(30) FRAME
25(30) FRAME
PAUSE
PAUSE
REC
REC
REC
5 FRAME
PLAY
PLAY
20(25) FRAME PLAYBACK
20(25) FRAMES PLAYBACK
MODE
REC MODE
PAUSE
REVERSE
PAUSE
P.B.
REC
PAUSE
REVERSE
PAUSE
REC
LED
REC
PLAY
STILL/PAUSE
INSERT
PICTURE
E-E PICTURE
SOUND
E-E
DRUM MOTOR
REC
CAPSTAN MOTOR
REVERSE
P.B.
REC
REVERSE
P.B.
REC
PINCH SOLENOID
ON
REEL MOTOR
OFF
REV.
FWD
OFF
REV
FWD
OFF
FULL ERASE HEAD
ON
OFF
ON
OFF
ON
VIDEO HEAD
REC
OFF
REC
OFF
REC
AUDIO ERASE HEAD
ON
OFF
ON
OFF
ON
AUDIO HEAD
REC
OFF
REC
OFF
REC
CONTROL HEAD
REC
PB
REC
PB
REC

Fig. 3-17 The timing chart of the assembly editing

The servo system is synchronized to the control signal previously recorded on the tape during insert editing. In the normal playback mode, the capstan servo circuit is synchronized to an internal crystal oscillator and control is performed by comparison with the control signal phase. However, during insert editing, control is performed in synchronization with the input video signal. Thus, in effect, the system functions from external sync in the playback mode.

Proper adjustment of the TRACKING control is important during insert editing since the capstan servo circuit functions by playing back the control signal and adjusting the recording signal phase. This is particularly important when using a tape that was recorded on another VHS machine. If tracking error is present during insert editing, the lack of phase alignment between the base and newly recorded tracks could cause tracking problems.

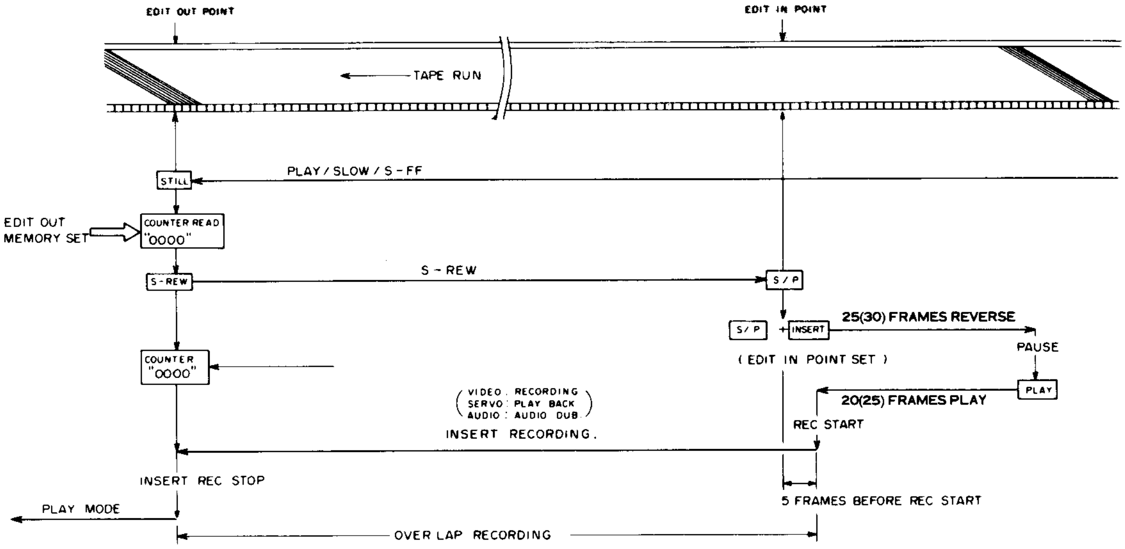

EDIT OUT POINT
EDIT IN POINT
TAPE RUN
PLAY / SLOW / S - FF
STILL
EDIT OUT MEMORY SET
COUNTER READ "0000"
S - REW
S - REW
S / P
S / P
INSERT
25(30) FRAMES REVERSE
PAUSE
(EDIT IN POINT SET)
COUNTER "0000"
VIDEO : RECORDING
SERVO : PLAY BACK
AUDIO : AUDIO DUB
INSERT RECORDING.
PLAY
20(25) FRAMES PLAY
REC START
INSERT REC STOP
PLAY MODE
5 FRAMES BEFORE REC START
OVER LAP RECORDING

Fig. 3-18 Insert editing

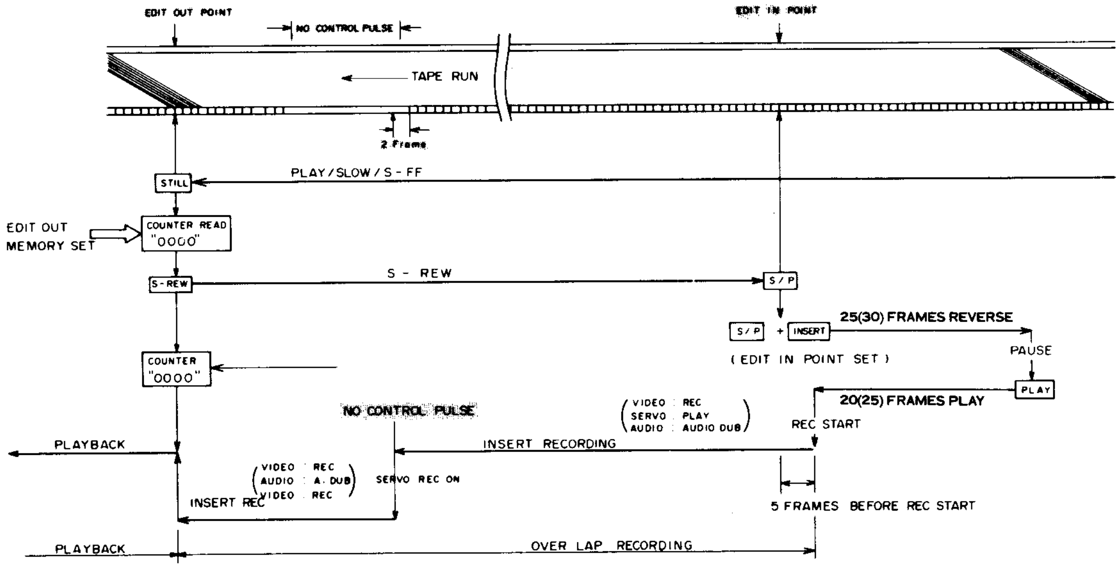

EDIT OUT POINT
NO CONTROL PULSE
EDIT IN POINT
TAPE RUN
2 Frame
PLAY / SLOW / S - FF
STILL
EDIT OUT MEMORY SET
COUNTER READ "0000"
S - REW
S - REW
S / P
S / P
INSERT
25(30) FRAMES REVERSE
PAUSE
(EDIT IN POINT SET)
COUNTER "0000"
NO CONTROL PULSE
VIDEO : REC
SERVO : PLAY
AUDIO : AUDIO DUB
PLAY
20(25) FRAMES PLAY
REC START
PLAYBACK
INSERT RECORDING
VIDEO : REC
AUDIO : A. DUB
VIDEO : REC
SERVO REC ON
INSERT REC
5 FRAMES BEFORE REC START
PLAYBACK
OVER LAP RECORDING

Fig. 3-19 Insert recording without control signal

3. Insert editing procedure

The timing chart of the insert editing is shown in Fig. 3-19.

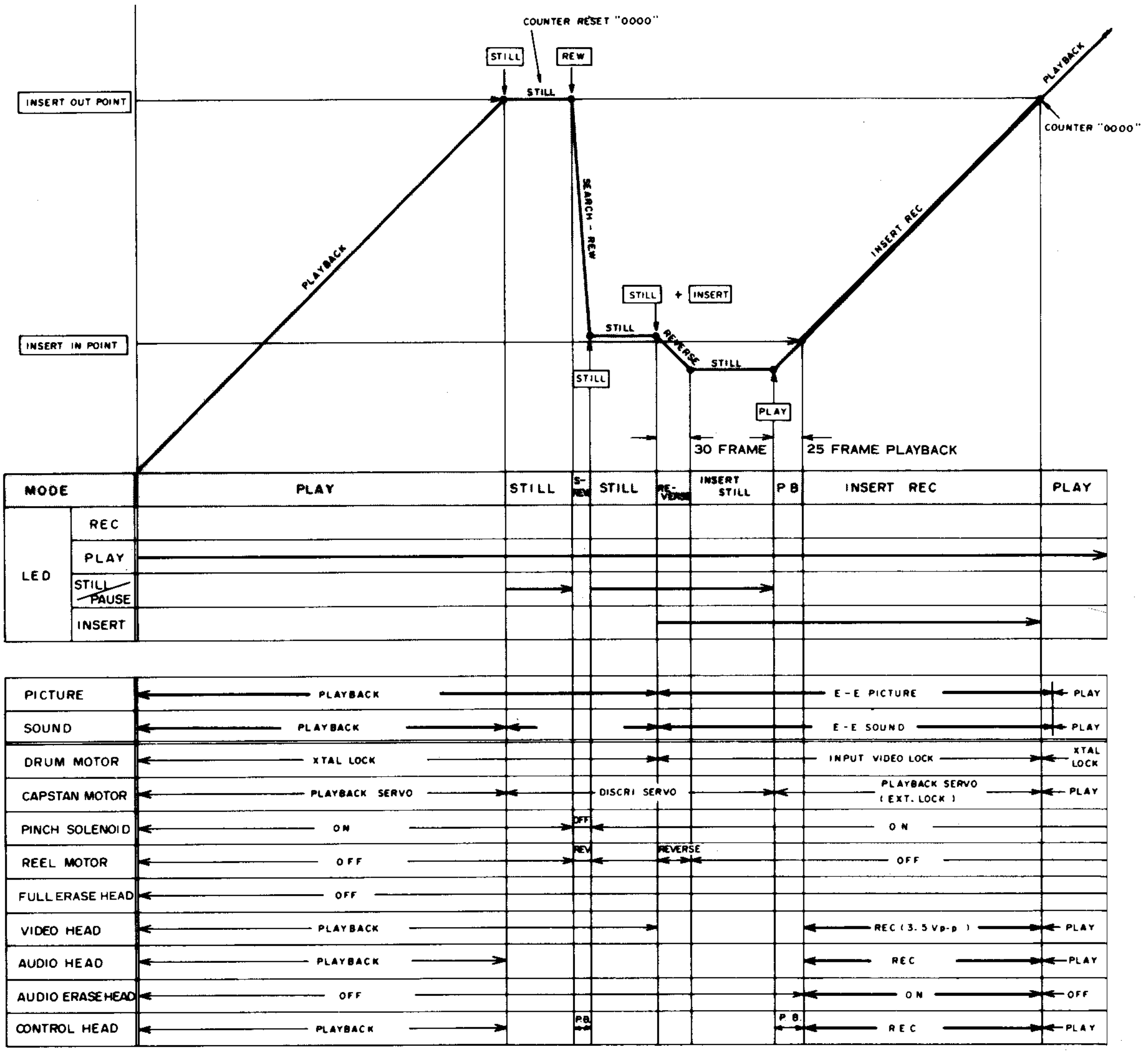

COUNTER RESET "0000"
STILL
REW
STILL
INSERT OUT POINT
PLAYBACK
SEARCH - REW
STILL + INSERT
STILL
INSERT IN POINT
STILL
REVERSE
STILL
PLAY
30 FRAME
25 FRAME PLAYBACK
INSERT REC
PLAYBACK
COUNTER "0000"
MODE
PLAY
STILL
S-REW
STILL
RE-VERSE
INSERT STILL
PB
INSERT REC
PLAY
LED
REC
PLAY
STILL/PAUSE
INSERT
PICTURE
PLAYBACK
E-E PICTURE
PLAY
SOUND
PLAYBACK
E-E SOUND
PLAY
DRUM MOTOR
XTAL LOCK
INPUT VIDEO LOCK
XTAL LOCK
CAPSTAN MOTOR
PLAYBACK SERVO
DISCRI SERVO
PLAYBACK SERVO (EXT. LOCK)
PLAY
PINCH SOLENOID
ON
OFF
ON
REEL MOTOR
OFF
REV
REVERSE
OFF
FULL ERASE HEAD
OFF
VIDEO HEAD
PLAYBACK
REC (3.5 Vp-p)
PLAY
AUDIO HEAD
PLAYBACK
REC
PLAY
AUDIO ERASE HEAD
OFF
ON
OFF
CONTROL HEAD
PLAYBACK
PB
P B.
REC
PLAY

Fig. 3-20 Timing chart of insert editing

Before proceeding, check that A) the control signal is properly recorded on the tape and B) playback tracking is correctly adjusted for the tape to be edited.

1) Set insert editing end point
   Play back the tape end, at the point insert editing is to end, press the counter RESET button. This resets the counter to 0000 and automatically sets the insert editing end point.
2) Set insert editing start point
   After setting the end point, rewind the tape (or use search rewind) and determine the editing start point. At this point, press the STILL button. Then, to set the insert editing mode, simultaneously press the STILL and INSERT buttons.
3) Back space operation
   When the insert mode is set, the capstan motor rotates in reverse for one second to rewind 30 frames of tape. This operation is controlled by the capstan FG pulse. At completion of reverse rotation, the capstan motor stops and the machine enters the pause mode.
4) Insert editing start
   Press the PLAY button to begin insert editing. 25 frames are played back in order to synchronize the capstan servo, then insert editing begins at the CH-1 video head switching point.
5) End point operation
   Insert editing continues until the tape counter reaches 0000 or the STOP button is pressed. At the insert editing end point, the capstan servo circuit switches over from the input video signal to the internal crystal oscillator. Although this results in some disturbance in the monitored (E-E) picture, it does not affect the insert editing end point.

3.2.6 CPU controlled slow and still modes

1. These modes are controlled by a newly developed 4 bit CPU system which possesses the following features.
   1) Even with tapes recorded on another (VHS) machine, optimum slow and still pictures are automatically adjusted.
   2) The system does not depend on the control signal recorded on the tape. Therefore, a monostable multivibrator system for control signal adjustment during recording and playback is not required.
   3) A slow tracking control is not required.
   4) Detection is performed for the FM signal and the FM noise position during slow and still.
   5) The previously required four adjustments for slow motion have been reduced to two.
   6) The servo board CPU (IC6) controls tape start and stop during slow and still modes, eliminating the need for complex additional circuits.
2. IC6 of the servo board and IC5 of the mechacon board, perform control for fine slow operation. The slow, still or frame advance signal from mechacon IC5 goes to servo IC6 to initiate the fine slow process. The following operations are then performed in sequence.
   1) Capstan motor stops.
   2) FM noise position is checked at the tape stopping point.
   3) The FM noise position address is derived from the drum FG count.
   4) FM noise position relative to the drum flipflop (CH-1 or CH-2) is computed.
   5) Capstan motor pulse output is produced.
   6) Return to step 2.
   7) Operation stops at the point the noise is eliminated from the picture.
   8) The capstan motor pulse output is obtained for a maximum of 8 times. If noise is not eliminated from the picture within these repetitions, operation stops at the 8th time.
3. FM noise position detection
   As indicated in Fig. 3-21, the CPU produces the slow pulse output and at the point the tape stops, the FM noise position is detected. When the tape stops completely, the CPU checks the FM noise position from the first drum flipflop rising pulse (CH-1 start).

   If the FM noise is positioned at the CH-1 and CH-2 switching point, or if it is undetected, the CPU determines that the motor advance pulse at the time is the best. In the case when the FM noise is at the CH-1 side, the CPU determines that the previous motor advance pulses was too short, then emits a pulse of slightly longer duration to shift the FM noise position rearward. Conversely, with the noise at the CH-2 side, the CPU interprets an excessively long pulse and sends a shorter one. In this manner, the FM noise position is detected and the capstan motor pulse width adjusted to remove noise from the slow/still picture.
4. FM noise calculation and slow pulse
   For accurate detection of the FM noise position, the CPU employs the 25 (30) Hz drum flipflop and 1600 (1920) Hz drum FG signals, as shown in Fig. 3-22.
   The drum turns 25 (30) times per second and the drum FG signal obtained from this rotation becomes 1600 (1920) Hz. By comparing this 1600 (1920) Hz with the drum flipflop signal, 60 drum FG cycles are obtained for each drum flipflop cycle.

   The CPU counts the rise and fall components of this 60 cycle drum FG signal, yielding 120 counts for each cycle of the drum flipflop. This 120 count is employed as the FM noise position address signal.

   Thus, an address signal below 60 indicates the FM noise position at CH-2, above 60 indicates CH-1, and at 60 becomes the optimum FM noise position. In this manner, the CPU detects the position of the FM noise from the address obtained from the drum FG signal and FM AGC output signal, then adjusts the width of the next capstan motor advance pulse.

   As an example, assume the FM noise is at CH-1. The CPU operation then becomes as follows.
   At the drum flipflop fall (CH-2 start point), the FM AGC DC component is applied to the CPU. The FM AGC input is 0 V DC with a normal FM waveform, but becomes a high pulse with the presence of level reduction (noise) in the FM waveform.
   The CPU continues counting the drum FG pulse until the FM AGC input goes high. In the Fig. 3-21 example, this occurs at count 30. Consequently, FG counter address 30 becomes entered into the memory as the noise start point. Thereafter, the CPU continues counting until the FM AGC input goes low (address 40 in the sample), and this becomes entered into the memory as the noise end point.

   From these data, the CPU computes the noise center as follows.

   $$\frac{\text{Noise start (30)} + \text{Noise end (40)}}{2} = \text{Noise center (35)}$$

   After detecting the noise center address, the CPU determines the channel of the noise.

   Best noise point (60) – Noise center (35) = 25

   A positive value indicates FM noise position at the CH-2 side, while a negative value signifies the CH-1 side. A zero result denotes the optimum stopping point.

   The CPU then decides the capstan motor pulse. For the sake of illustration, assume that the FM noise is at the CH-1 side and the noise center at 35. The CPU calculation becomes:

   Best noise point (60) – Noise center (35) = 25

In this example, the noise position is at CH-1 and from the above data, the CPU determines that the previous motor pulse was too short by an amount corresponding to 25 address counts. The CPU then increases the length of the following pulse in proportion to 25 address counts, thereby setting the FM noise to the center 60 position.

5. Fine slow/still operation

Refer to the timing chart. Pressing the SLOW/STILL button during playback sends the slow/still command to servo board CPU IC6, thereby setting the CPU to the slow/still mode.

The CPU begins counting from the CH-1 start point and after a fixed time period (a), the capstan motor is stopped. The CPU then detects the FM waveform from the CH-2 start point.

In this example, the FM noise is not detected. Therefore, the CPU issues the standard motor advance pulse output. After a fixed period from CH-1 start (d), a 60 msec motor pulse output is produced, which stops after time period (c).

The FM waveform is then detected. If FM noise is detected, the CPU computes the noise center address (f) and the time difference (g) from the optimum position. The motor pulse start (h) and stop (l) points are determined, after which the motor pulse output is produced.

In this manner, the noise position of the FM waveform is detected with every pulse input. If the optimum point is yielded twice in succession, the operation completes to provide a noise free still picture output.

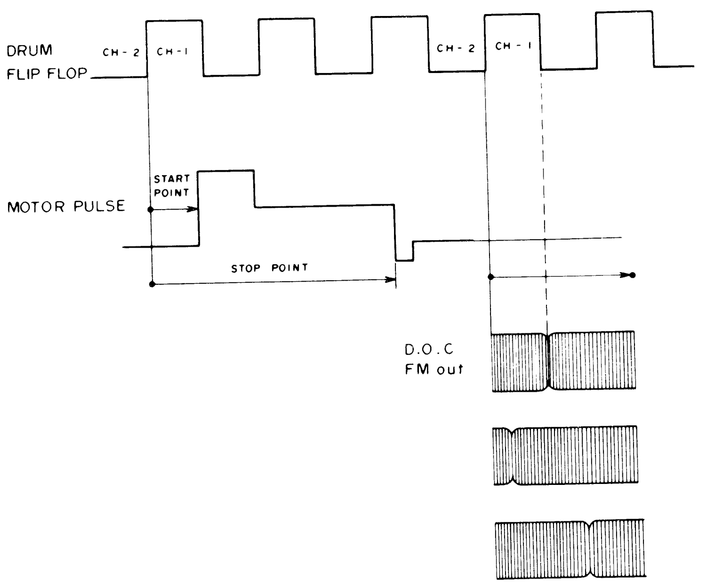

DRUM
FLIP FLOP
CH-2
CH-1
CH-2
CH-1
MOTOR PULSE
START POINT
STOP POINT
D.O.C
FM out

Fig. 3-21 CPU slow control

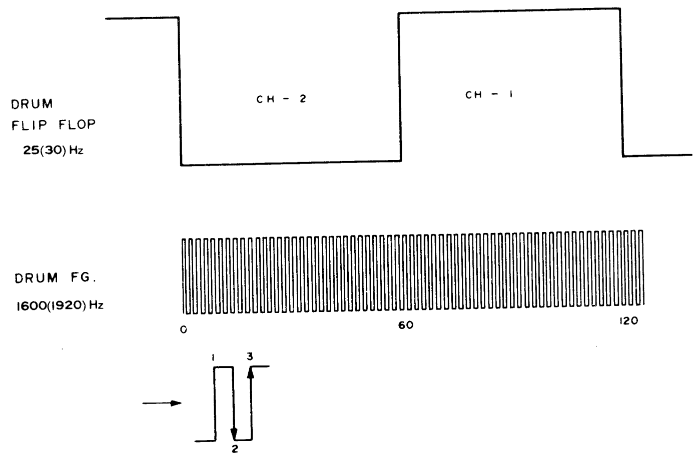

DRUM
FLIP FLOP
25(30) Hz
CH-2
CH-1
DRUM FG.
1600(1920) Hz
0
60
120
1
3
2

Fig. 3-22 Slow/still control

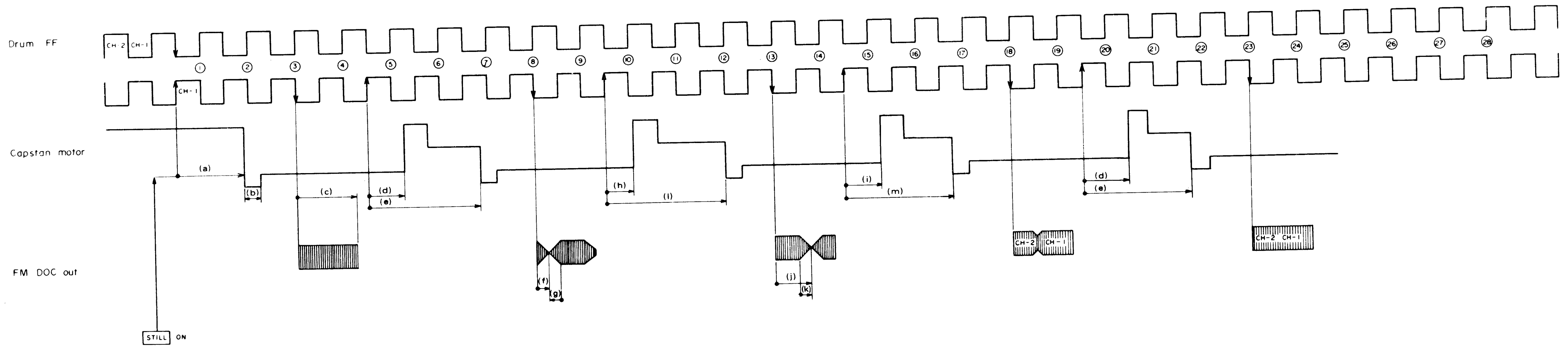

Drum FF
CH 2
CH-1
CH-1
① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨ ⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱ ⑲ ⑳ ㉑ ㉒ ㉓ ㉔ ㉕ ㉖ ㉗ ㉘
Capstan motor
(a)
(b)
(c)
(d)
(e)
(h)
(l)
(i)
(m)
(d)
(e)
FM DOC out
(f)
(g)
(j)
(k)
CH-2
CH-1
CH-2
CH-1
STILL
ON

Fig. 3-23 Slow control timing chart

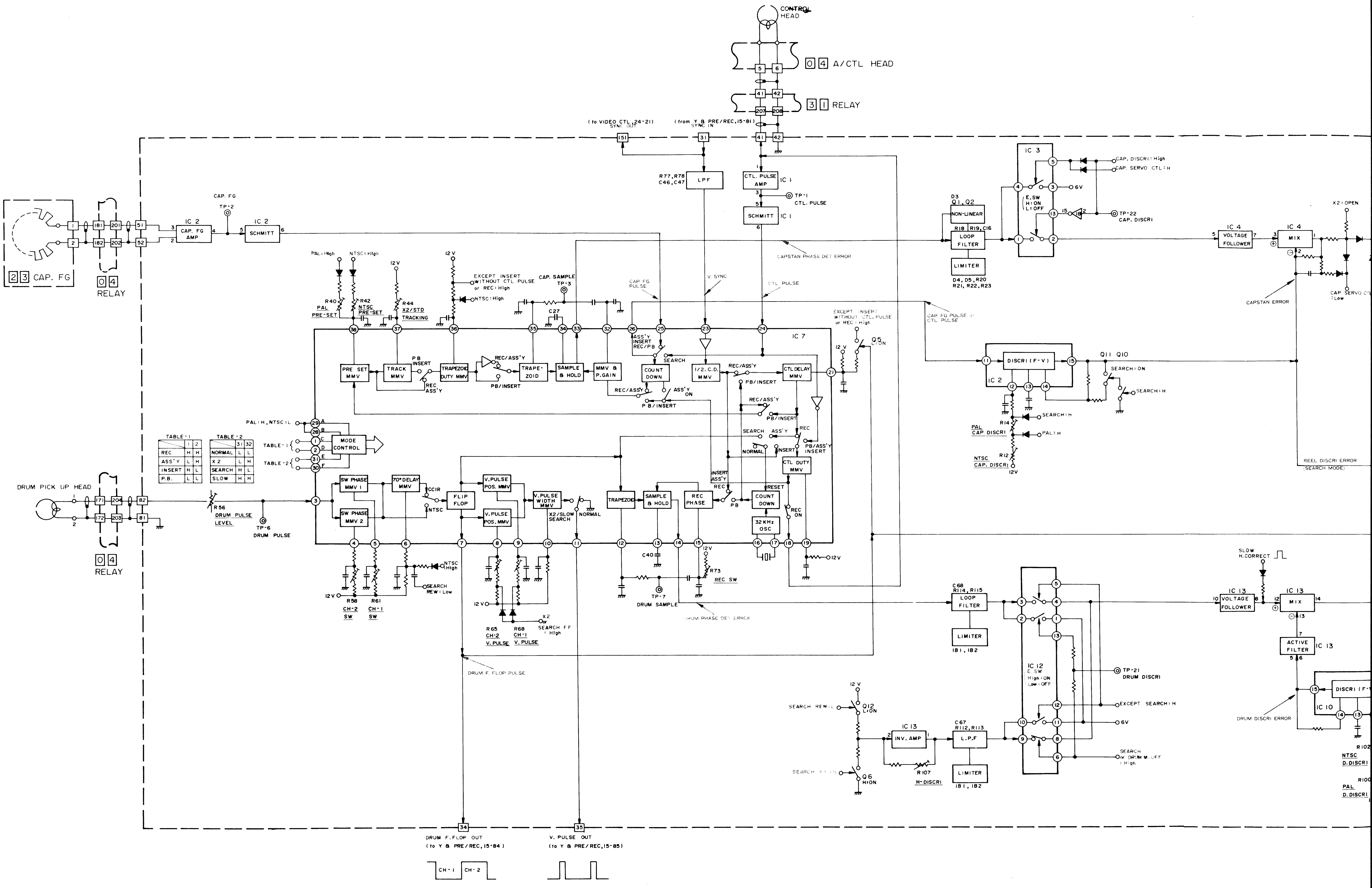

CONTROL HEAD
04 A/CTL HEAD
31 RELAY
(to VIDEO CTL,24-21) SYNC OUT
(from Y & PRE/REC,15-81) SYNC IN
R77,R78 C46,C47
LPF
CTL. PULSE AMP
IC 1
TP-1 CTL. PULSE
SCHMITT
CAP. FG TP-2
IC 2 CAP. FG AMP
IC 2 SCHMITT
23 CAP. FG
04 RELAY
CAPSTAN PHASE DET ERROR
V. SYNC
CTL PULSE
CAP. FG PULSE
CAP. SAMPLE TP-3
EXCEPT INSERT WITHOUT CTL PULSE or REC: High
NTSC: High
PAL: High
12 V
R40 PAL PRE-SET
R42 NTSC PRE-SET
R44 X2/STD TRACKING
C27
IC 7
PRE SET MMV
TRACK MMV
PB INSERT
REC ASS'Y
TRAPEZOID DUTY MMV
REC/ASS'Y
PB/INSERT
TRAPE-ZOID
SAMPLE & HOLD
MMV & P.GAIN
ASS'Y INSERT REC/PB
SEARCH
COUNT DOWN
REC/ASS'Y
P B/INSERT
ASS'Y ON
1/2.C.D. MMV
REC/ASS'Y
PB/INSERT
CTL DELAY MMV
Q5 L:ON
PAL: H, NTSC: L
TABLE-1
TABLE-2
MODE CONTROL
SEARCH
ASS'Y
NORMAL
INSERT
REC
PB/ASS'Y INSERT
CTL DUTY MMV
DRUM PICK UP HEAD
04 RELAY
R 56 DRUM PULSE LEVEL
TP-6 DRUM PULSE
SW PHASE MMV 1
SW PHASE MMV 2
70° DELAY MMV
CCIR
NTSC
FLIP FLOP
V. PULSE POS. MMV
V. PULSE POS. MMV
V. PULSE WIDTH MMV
X2/SLOW SEARCH
NORMAL
TRAPEZOID
SAMPLE & HOLD
REC PHASE
INSERT ASS'Y
REC
PB
RESET
COUNT DOWN
32 KHz OSC
REC ON
12V
C40
TP-7 DRUM SAMPLE
R73 REC SW
DRUM PHASE DET ERROR
12V
R58 CH-2 SW
R61 CH-1 SW
NTSC: High
SEARCH REW: Low
R65 CH-2 V. PULSE
R68 CH-1 V. PULSE
X2
SEARCH FF: High
DRUM F. FLOP PULSE
DRUM F. FLOP OUT (to Y & PRE/REC,15-84)
V. PULSE OUT (to Y & PRE/REC,15-85)
CH-1
CH-2
IC 3
CAP. DISCRI: High
CAP. SERVO CTL: H
6V
E.SW H: ON L: OFF
TP-22 CAP. DISCRI
D3 Q1,Q2
NON-LINEAR
R18 R19,C16
LOOP FILTER
LIMITER
D4, D5, R20 R21, R22, R23
IC 4 VOLTAGE FOLLOWER
IC 4 MIX
X2: OPEN
CAPSTAN ERROR
CAP. SERVO CTL: Low
CAP. FG PULSE or CTL PULSE
EXCEPT INSERT WITHOUT CTL PULSE or REC: High
Q11 Q10
DISCRI (F-V)
IC 2
SEARCH: ON
SEARCH: H
SEARCH: H
PAL: H
R14 PAL CAP. DISCRI
R12 NTSC CAP. DISCRI
12V
REEL DISCRI ERROR (SEARCH MODE)
SLOW H. CORRECT
IC 13 VOLTAGE FOLLOWER
IC 13 MIX
ACTIVE FILTER IC 13
C68 R114, R115
LOOP FILTER
LIMITER
181, 182
IC 12 E.SW High: ON Low: OFF
TP-21 DRUM DISCRI
EXCEPT SEARCH: H
6V
SEARCH or DRUM M. OFF: High
12 V
SEARCH REW: L
Q12 L: ON
SEARCH FF: H
Q6 H: ON
IC 13 INV. AMP
R107 H-DISCRI
C67 R112, R113
L.P.F
LIMITER
181, 182
DRUM DISCRI ERROR
DISCRI (F-V)
IC 10
R102 NTSC D. DISCRI
R100 PAL D. DISCRI

TABLE-1

	1	2
REC	H	H
ASS'Y	L	H
INSERT	H	L
P.B.	L	L

TABLE-2

	31	32
NORMAL	L	L
X 2	L	H
SEARCH	H	L
SLOW	H	H

Fig. 3-24 Servo system block diag

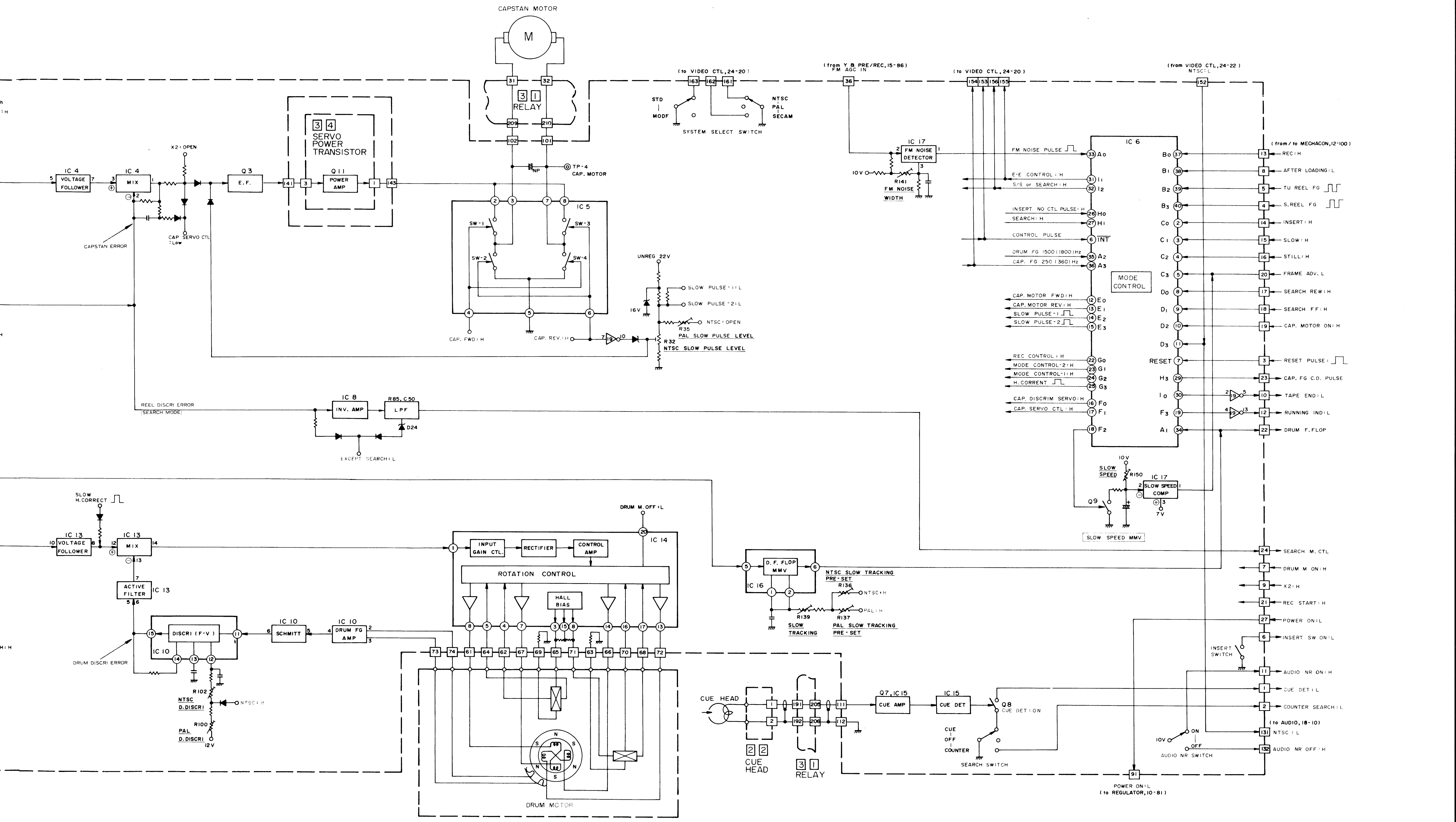

CAPSTAN MOTOR
M
31 RELAY
34 SERVO POWER TRANSISTOR
Q11 POWER AMP
Q3 E.F.
IC 4 VOLTAGE FOLLOWER
IC 4 MIX
X2 : OPEN
CAP SERVO CTL : Low
CAPSTAN ERROR
TP-4 CAP. MOTOR
NP
IC 5
SW-1
SW-2
SW-3
SW-4
CAP. FWD : H
CAP. REV. : H
UNREG 22V
16V
SLOW PULSE-1 : L
SLOW PULSE-2 : L
NTSC : OPEN
R35 PAL SLOW PULSE LEVEL
R32 NTSC SLOW PULSE LEVEL
(to VIDEO CTL, 24-20)
STD
MODF
NTSC
PAL
SECAM
SYSTEM SELECT SWITCH
(from Y & PRE/REC, 15-86) FM AGC IN
IC 17 FM NOISE DETECTOR
10V
R141 FM NOISE WIDTH
(to VIDEO CTL, 24-20)
(from VIDEO CTL, 24-22) NTSC : L
IC 6
MODE CONTROL
FM NOISE PULSE
E-E CONTROL : H
S/S or SEARCH : H
INSERT NO CTL PULSE : H
SEARCH : H
CONTROL PULSE
DRUM FG 1500 (1800) Hz
CAP. FG 250 (360) Hz
CAP. MOTOR FWD : H
CAP. MOTOR REV : H
SLOW PULSE-1
SLOW PULSE-2
REC CONTROL : H
MODE CONTROL-2 : H
MODE CONTROL-1 : H
H. CORRENT
CAP. DISCRIM SERVO : H
CAP. SERVO CTL : H
A0 I1 I2 H0 H1 INT A2 A3 E0 E1 E2 E3 G0 G1 G2 G3 F0 F1 F2
B0 B1 B2 B3 C0 C1 C2 C3 D0 D1 D2 D3 RESET H3 I0 F3 A1
(from/to MECHACON, 12-100)
REC : H
AFTER LOADING : L
TU REEL FG
S. REEL FG
INSERT : H
SLOW : H
STILL : H
FRAME ADV. L
SEARCH REW : H
SEARCH FF : H
CAP. MOTOR ON : H
RESET PULSE
CAP. FG C.D. PULSE
TAPE END : L
RUNNING IND : L
DRUM F. FLOP
SLOW SPEED
R150
IC 17 SLOW SPEED COMP
Q9
7V
SLOW SPEED MMV
REEL DISCRI ERROR (SEARCH MODE)
IC 8 INV. AMP
R85, C50 LPF
D24
EXCEPT SEARCH : L
SEARCH M. CTL
DRUM M ON : H
X2 : H
REC START : H
POWER ON : L
INSERT SW ON : L
INSERT SWITCH
AUDIO NR ON : H
CUE DET : L
COUNTER SEARCH : L
(to AUDIO, 18-10)
NTSC : L
AUDIO NR OFF : H
AUDIO NR SWITCH
SLOW H. CORRECT
IC 13 VOLTAGE FOLLOWER
IC 13 MIX
IC 13 ACTIVE FILTER
IC 10 DISCRI (F-V)
DRUM DISCRI ERROR
R102 NTSC D.DISCRI
NTSC : H
R100 PAL D.DISCRI
12V
IC 10 SCHMITT
IC 10 DRUM FG AMP
DRUM M. OFF : L
IC 14
INPUT GAIN CTL.
RECTIFIER
CONTROL AMP
ROTATION CONTROL
HALL BIAS
DRUM MOTOR
IC 16 D. F. FLOP MMV
NTSC SLOW TRACKING PRE-SET
R136 NTSC : H
R139 SLOW TRACKING
R137 PAL : H
PAL SLOW TRACKING PRE-SET
CUE HEAD
22 CUE HEAD
31 RELAY
Q7, IC15 CUE AMP
IC 15 CUE DET
Q8 CUE DET : ON
CUE OFF COUNTER
SEARCH SWITCH
10V ON OFF
POWER ON : L (to REGULATOR, 10-81)

Fig. 3-24 Servo system block diagram

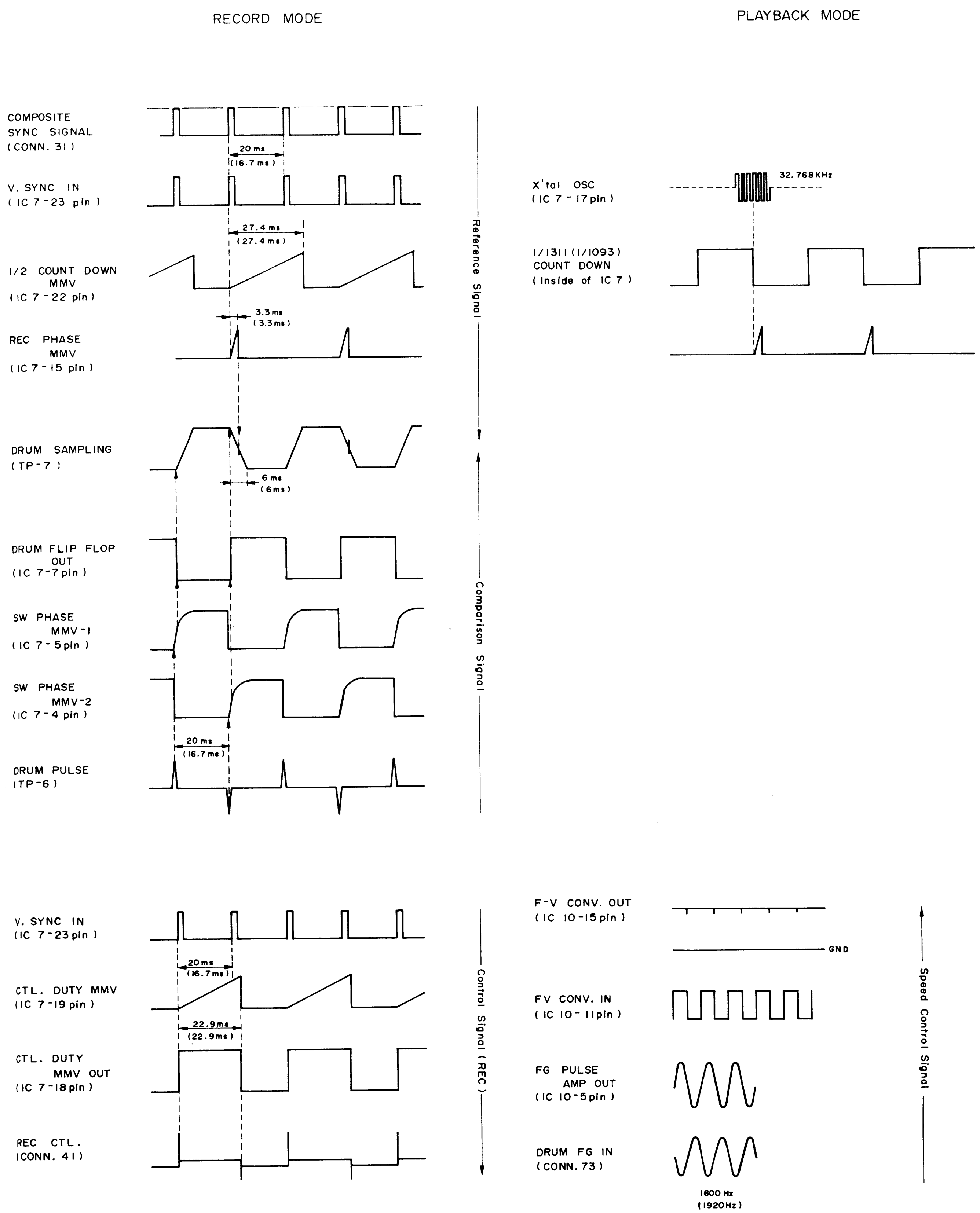

RECORD MODE
PLAYBACK MODE
COMPOSITE SYNC SIGNAL (CONN. 31)
20 ms (16.7 ms)
V. SYNC IN (IC 7-23 pin)
27.4 ms (27.4 ms)
1/2 COUNT DOWN MMV (IC 7-22 pin)
3.3 ms (3.3 ms)
REC PHASE MMV (IC 7-15 pin)
DRUM SAMPLING (TP-7)
6 ms (6 ms)
DRUM FLIP FLOP OUT (IC 7-7 pin)
SW PHASE MMV-1 (IC 7-5 pin)
SW PHASE MMV-2 (IC 7-4 pin)
20 ms (16.7 ms)
DRUM PULSE (TP-6)
Reference Signal
Comparison Signal
X'tal OSC (IC 7-17 pin)
32.768KHz
1/1311 (1/1093) COUNT DOWN (Inside of IC 7)
V. SYNC IN (IC 7-23 pin)
20 ms (16.7 ms)
CTL. DUTY MMV (IC 7-19 pin)
22.9 ms (22.9 ms)
CTL. DUTY MMV OUT (IC 7-18 pin)
REC CTL. (CONN. 41)
Control Signal (REC)
F-V CONV. OUT (IC 10-15 pin)
GND
FV CONV. IN (IC 10-11 pin)
FG PULSE AMP OUT (IC 10-5 pin)
DRUM FG IN (CONN. 73)
1600 Hz (1920 Hz)
Speed Control Signal

Fig. 3-25 Drum servo timing chart

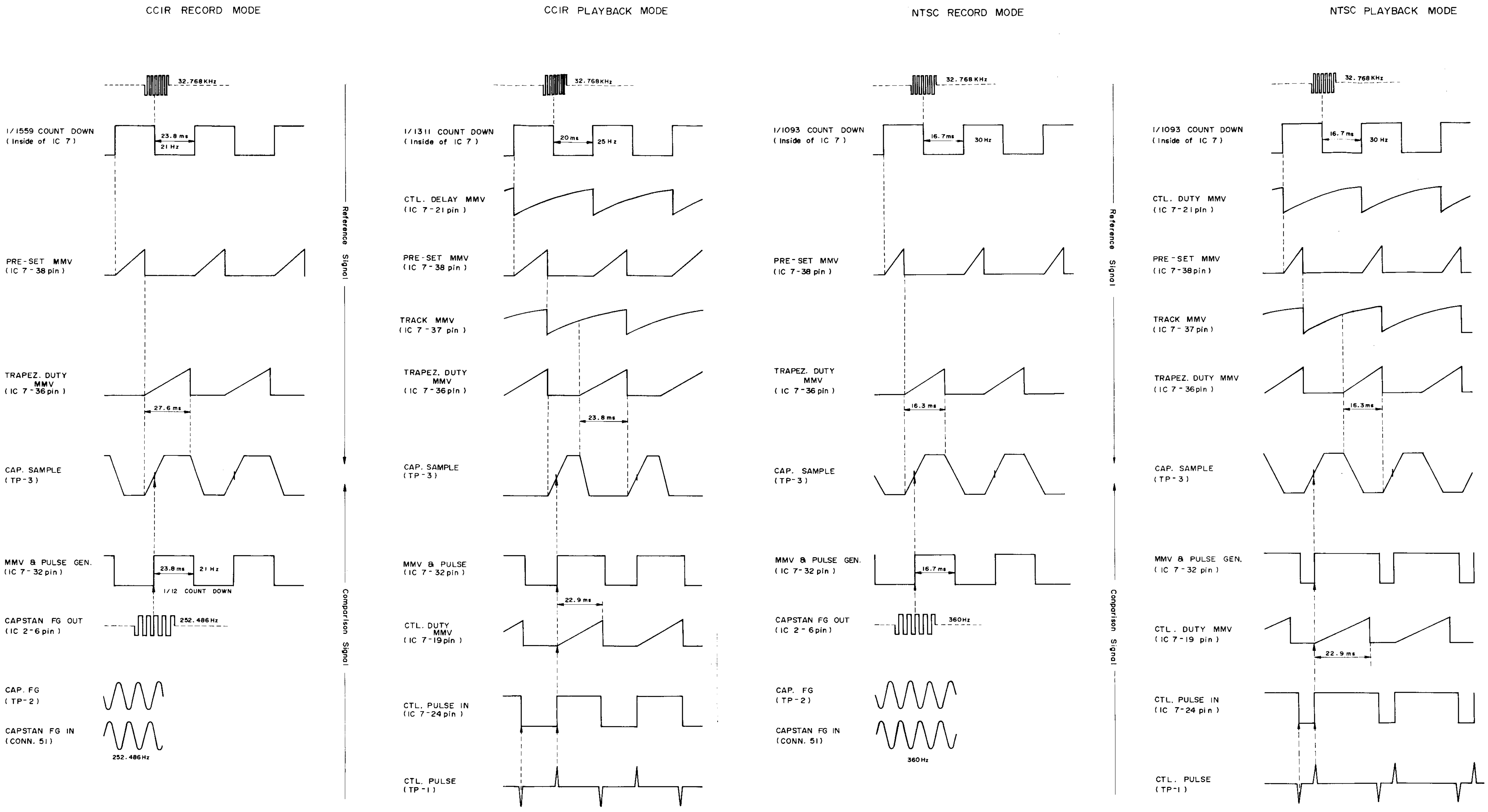

CCIR RECORD MODE
32.768KHz
1/1559 COUNT DOWN (Inside of IC 7)
23.8 ms
21 Hz
PRE-SET MMV (IC 7-38 pin)
TRAPEZ. DUTY MMV (IC 7-36pin)
27.6 ms
CAP. SAMPLE (TP-3)
MMV & PULSE GEN. (IC 7-32 pin)
23.8 ms
21 Hz
1/12 COUNT DOWN
CAPSTAN FG OUT (IC 2-6 pin)
252.486Hz
CAP. FG (TP-2)
CAPSTAN FG IN (CONN. 51)
252.486Hz
Reference Signal
Comparison Signal
CCIR PLAYBACK MODE
32.768KHz
1/1311 COUNT DOWN (Inside of IC 7)
20 ms
25 Hz
CTL. DELAY MMV (IC 7-21 pin)
PRE-SET MMV (IC 7-38 pin)
TRACK MMV (IC 7-37 pin)
TRAPEZ. DUTY MMV (IC 7-36pin)
23.8 ms
CAP. SAMPLE (TP-3)
MMV & PULSE (IC 7-32 pin)
22.9 ms
CTL. DUTY MMV (IC 7-19pin)
CTL. PULSE IN (IC 7-24 pin)
CTL. PULSE (TP-1)
NTSC RECORD MODE
32.768 KHz
1/1093 COUNT DOWN (Inside of IC 7)
16.7ms
30 Hz
PRE-SET MMV (IC 7-38 pin)
TRAPEZ. DUTY MMV (IC 7-36 pin)
16.3 ms
CAP. SAMPLE (TP-3)
MMV & PULSE GEN. (IC 7-32 pin)
16.7 ms
CAPSTAN FG OUT (IC 2-6pin)
360Hz
CAP. FG (TP-2)
CAPSTAN FG IN (CONN. 51)
360Hz
Reference Signal
Comparison Signal
NTSC PLAYBACK MODE
32.768KHz
1/1093 COUNT DOWN (Inside of IC 7)
16.7ms
30 Hz
CTL. DUTY MMV (IC 7-21 pin)
PRE-SET MMV (IC 7-38pin)
TRACK MMV (IC 7-37 pin)
TRAPEZ. DUTY MMV (IC 7-36pin)
16.3ms
CAP. SAMPLE (TP-3)
MMV & PULSE GEN. (IC 7-32 pin)
CTL. DUTY MMV (IC 7-19 pin)
22.9 ms
CTL. PULSE IN (IC 7-24 pin)
CTL. PULSE (TP-1)

Fig. 3-26 Capstan servo timing chart

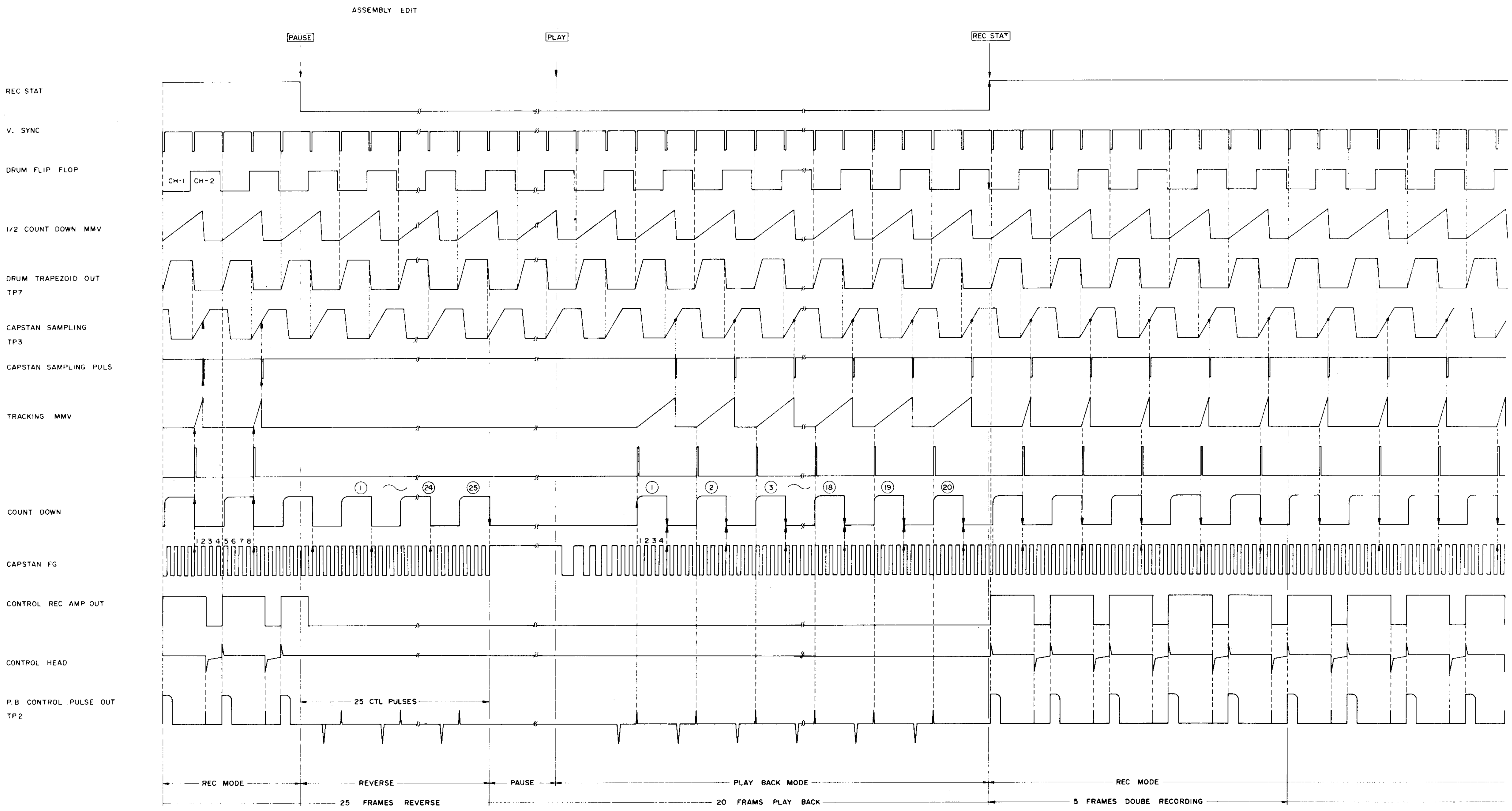

ASSEMBLY EDIT
PAUSE
PLAY
REC STAT
REC STAT
V. SYNC
DRUM FLIP FLOP
CH-1
CH-2
1/2 COUNT DOWN MMV
DRUM TRAPEZOID OUT
TP7
CAPSTAN SAMPLING
TP3
CAPSTAN SAMPLING PULS
TRACKING MMV
①
㉔
㉕
①
②
③
⑱
⑲
⑳
COUNT DOWN
1 2 3 4 5 6 7 8
1 2 3 4
CAPSTAN FG
CONTROL REC AMP OUT
CONTROL HEAD
P.B CONTROL PULSE OUT
TP2
25 CTL PULSES
REC MODE
REVERSE
PAUSE
PLAY BACK MODE
REC MODE
25 FRAMES REVERSE
20 FRAMS PLAY BACK
5 FRAMES DOUBE RECORDING

Fig. 3-27 Servo edit timing chart

3.3 VIDEO SYSTEM

3.3.1 General

Except for an occasional movie "classic", television broadcasts in recent years are nearly all in color. Furthermore, even with the now infrequent monochrome (black and white or b/w) broadcasts, it has become customary for broadcast stations to insert the color burst signal nevertheless. Consequently, circuits which formerly relied on the presence or absence of the burst signal for automatic switching between color and b/w modes are no longer of practical use. For this reason, this model does not include an automatic color killer circuit.

In practice, this trend is of minor consequence sicne the VHS format was originally developed on the premise that the input video signal would be in color.

The video mode select switch on the rear panel is provided with COLOR, B/W and CH SET positions. Normally the switch is set to the COLOR position, regardless of the input signal. When it is clear that the signal to be recorded or played back is b/w, the user can set the switch to B/W, thereby cutting off color noise which may appear in the picture. However, with this model, the recording frequency bandwidth of the luminance signal is not increased in the b/w mode.

Typically, the CH SET position is employed only when installing the set. At this position, the built-in video signal generator output through the RF converter is obtained at CH-36 for use in tuning the TV receiver.

The following circuit description is in reference to the block diagram.

3.3.2 Video control system

This model possesses capability for distinguishing among PAL, SECAM (standard), SECAM (modified, i.e., "ME-SECAM"), NTSC (standard) and NTSC (modified) systems for recording and playback. Single chip microprocessor IC1 of the VIDEO CONTROL board performs this detection and supplies the relevant data to other circuits.

In order to conserve power, the power supply is cutoff from those circuits which are not required in the particular mode.

Input and output data for IC1 and the VIDEO CONTROL board are indicated in the schematic diagram for reference during service. The decision flowchart for the microprocessor is depicted in Figs. 3-28 and 3-29.

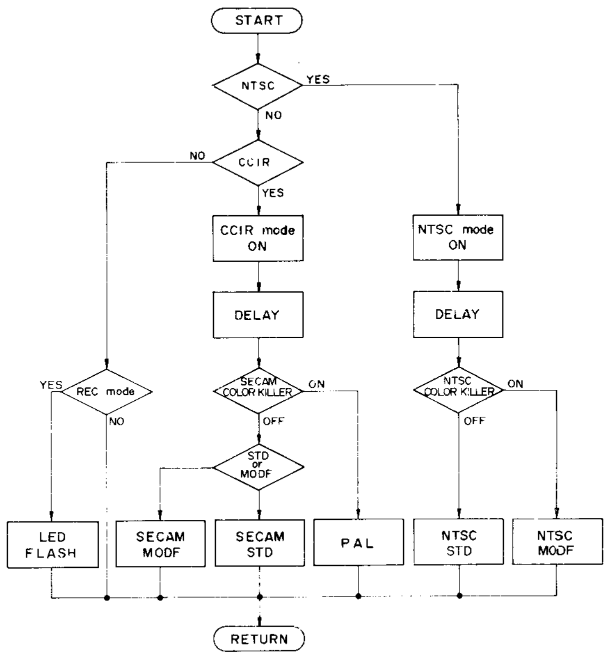

START
NTSC
YES
NO
CCIR
NO
YES
CCIR mode ON
NTSC mode ON
DELAY
DELAY
YES
REC mode
NO
SECAM COLOR KILLER
ON
OFF
NTSC COLOR KILLER
ON
OFF
STD or MODF
LED FLASH
SECAM MODF
SECAM STD
PAL
NTSC STD
NTSC MODF
RETURN

Fig. 3-28 Video signal det. (REC mode)

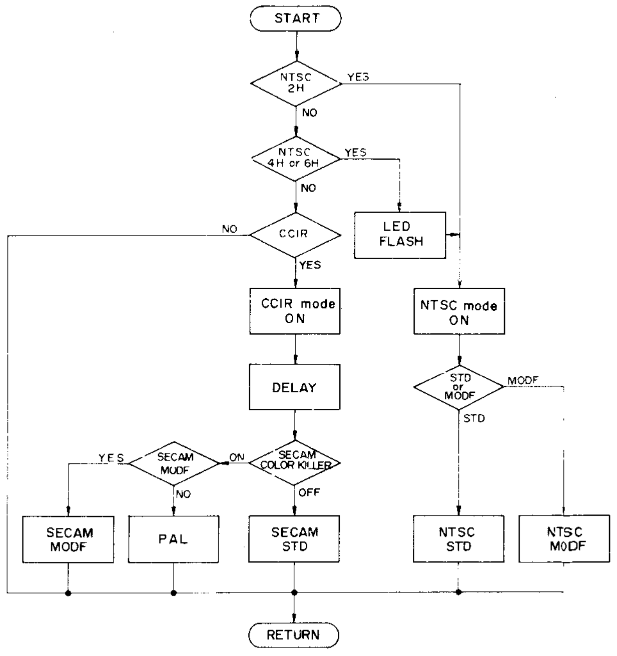

START
NTSC 2H
YES
NO
NTSC 4H or 6H
YES
NO
NO
CCIR
YES
LED FLASH
CCIR mode ON
NTSC mode ON
DELAY
STD or MODF
MODF
STD
YES
SECAM MODF
NO
ON
SECAM COLOR KILLER
OFF
SECAM MODF
PAL
SECAM STD
NTSC STD
NTSC MODF
RETURN

Fig. 3-29 Video signal det. (PB mode)

3-28

3.3.3 Luminance signal system

Refer to the luminance signal block diagram of Fig. 3-35.

1. Recording system

Video inputs consist of tuner, auxiliary (AUX) and camera. At the VIDEO CONTROL board, the TV broadcast signal selected by the tuner is demodulated and supplied as a video signal to connector 221. If an auxiliary video signal source is connected to the rear panel, this becomes supplied to connector 213. Similarly, a video signal via the CAMERA connector becomes applied to connector 111.

The user employs the REC SELECT switch to choose the desired of the three inputs. This is coupled with electronic switch IC3, which is off during playback and cutoff from succeeding circuits.

An emitter-follower converts the impedance of the signal through IC3, which then goes via connector 182, the NTSC COLOR board and the COLOR board to connector 51 of the Y & PRE/REC board.
This video signal is supplied to IC106 pin 26.

The keyed AGC (automatic gain control) circuit functions to control the sync level of the video signal for a fixed value, after which the output is obtained through SW-2 at IC106 pin 24.

Emitter-follower Q110 converts the impedance and supplies the signal to Q108.
L109 and C125 function only during playback mode.

Emitter-follower Q108 converts the impedance and lowpass filter removes the unnecessary highband color component. Between Q108 and LPF, a series resonance trap formed by Lxxx and Cxxx functions as a subfilter trap for LPF and attenuates the center energy band of the color signal. The trap possesses a center at the color subcarrier frequency.

At equalizer, the luminance signal is delayed approximately 600 nanoseconds (600 x 10^{-9} sec) to match the timing with the color signal on the recorded tape pattern. The combined response of LPF and EQ serves to improve the pulse response of the luminance signal.

Emitter-follower Q104 again converts the impedance of the signal from EQ and supplies it to IC106 pin 13, where it is amplified to a level sufficient for driving the pre-emphasis and frequency modulator circuits. The signal is obtained via SW-3 from IC106 pin 14.

The pin 14 output is branched into two lines. One of these goes through C183 to IC106 pin 28 and through a lowpass filter to pin 1 for the keyed AGC detector.

The second line is for luminance signal processing and enters IC106 pin 18 through low pass filter formed by C186 and L131 for supply to the clamp, nonlinear pre-emphasis and main pre-emphasis circuits.

The nonlinear pre-emphasis circuit functions to automatically vary the pre-emphasis amount according to the input video signal level, increasing the amount at low signal levels, where noise is most easily apparent. In combination with the main pre-emphasis circuit, signal to noise ratio (S/N) is improved in the mid and high frequency regions of the signal. For this reason, a keyed AGC circuit is required, rather than a peak AGC circuit.

By applying pre-emphasis, strong waveform spikes are produced in the rise component from black to white level. Since this could cause black/white reversal effects, in addition to white and dark clipping, waveform shaping is performed to permit demodulation during playback.

Sync tip of the luminance signal from IC107 pin 18 is clamped at a fixed DC potential before going to the nonlinear pre-emphasis circuit. This is intended to reduce the amount of pre-emphasis at high level and high frequency.

Pre-emphasis is applied at the main pre-emphasis circuit without regard to level. White and dark clip circuits cut the spike components above and below fixed levels, and the resulting signal goes to the frequency modulator.

In another route, the signal from the white and dark clip circuits goes from IC107 pin 12 to emitter-follower Q138 for impedance conversion. De-emphasis is performed by an RLC circuit, demodulating the spike components. The signal then goes to the main pre-emphasis circuit where only the peaks of the spikes are compressed. This allows demodulation of the spike components during playback and improves S/N and pulse characteristics.

Pin 12 of IC107 is a fixed current power supply terminal. According to the DC potential of the video signal from the white and dark clipping circuits, the oscillation frequency of the frequency modulator (FM MOD) varies. The variation is linear with respect to the video signal DC potential.
As can be noted, the highband overshoot component lost by white clipping becomes effectively restored for driving the frequency modulator. Consequently, demodulation of the highband component is improved, together with S/N at high frequencies.

The 25 Hz drum flipflop signal is supplied to the common of R291 and R293 (CARRIER) in order to reduce visibility of the noise.

This model employs video heads track width more than 49 μm. During playback, a small crosstalk component is picked up from the adjacent track. Also, even a slight deviation from the horizontal correlation of the VHS recorded tape pattern sharply increases the crosstalk amount.

Due to the azimuth angle of the video head, the FM crosstalk component is located at the lower FM sideband, where the frequency is low. Through the demodulator, the crosstalk contributes to highband noise in the video signal.

By adding the 25 Hz drum flipflop signal to the frequency modulator, the FM carrier frequency of the CH-1 and CH-2 track components from the frequency modulators shifted by 1/2 Fh.

The sync tip FM carrier frequency of CH-1 track becomes 3.8 MHz and CH-2 becomes 3.8 MHz plus 1/2 Fh. Consequently, the sideband components of the CH-1 and CH-2 tracks become an interleaved frequency spectrum. When this is played back, the crosstalk component becomes offset by 1/2 line with respect to the main signal, thereby reducing visibility.

This FM carrier interleaving circuit improves edge noise which occurs at rapid transitions from black to white level.

R293 (R291) adjusts the sync tip to 3.8 (3.4) MHz and R203 (R201) adjusts for 100% white peak level at 4.8 (4.4) MHz. Since the high frequency component of the input luminance signal and the FM frequency are in the same region, it is important to avoid input leakage and obtain high linearity and symmetry in the output.

The FM luminance signal goes via SW-4 and IC107 pin 28 to the next stage highpass filter, which attenuates the lower sideband where the down converted color signal is to be inserted. Emitter-follower Q128 converts the impedance, after which the signal is mixed with the down converted color signal and supplied to recording amplifier REC AMP-1 at IC107. As indicated in the block diagram, this amplifier possesses the proper frequency characteristics for recording the FM signal on the tape. The recording current is selected for the optimum playback output with respect to the FM signal frequency.

From REC AMP-1, the signal goes to REC AMP-2, which is a broad-band amplifier. In order to match the low impedance of the rotary transformers and video heads, the SEPP (single ended push-pull) circuit of Q140 and Q141 supplies nearly a fixed current to the video heads.

The recording FM signal from REC AMP-2 is branched and go from conns. 111 and 116 to the rotary transformer. IC109 is an electronic switch which sets the rotary transformer and consequently the video heads for the recording or playback mode. In the recording mode, SW11 and SW14 are off, while SW12 and SW13 are on. Both CH-1 and CH-2 are grounded through 10 Ω resistors at conns. 112 and 115, setting the rotary transformers for the recording mode. Together with R251 (R249) these resistors adjust for the optimum recording current to the video heads.

Electronic switch Q130 is on in the E-E and REC modes, at which time R254 (470 Ω) attenuates the FM signal. However, during insert editing, the INSERT CTL command (low potential) at D106 cathode switches Q130 off. Consequently, the FM signal level supplied to the video heads becomes about 2.5 dB higher in the insert editing mode than during the normal recording mode.

The E-E output during recording is obtained from the keyed AGC circuit. This signal is mixed with color and goes via the E-E amplifier, switch SW5 and an emitter follower circuit to IC106 pin 5, then to the E-E video output.

2. Playback system

Electronic switches SW11 and SW14 are on during playback, while SW12 and SW13 are off. These states set the rotary transformers for the playback mode and the video heads pick-up the signal from the tape. The playback signal channels from the video heads go to the CH-1 and CH-2 pre-amplifiers of IC107, which are designed for both impedance matching between the video heads and rotary transformers, and optimum S/N.

Head resonance controls C333 & C334 and head quality factor controls R361 & R336 compensate for response differences between video heads and reduce S/N impairment due to such difference.

At the switching amplifier, the CH-1 and CH-2 segments are joined into a continuous signal in accordance with the drum flipflop signal, which is synchronized to video head rotation. The outputs of the two head channels are arranged with a front and back overlap of about 7 to 8H, which eliminates signal loss at the junctures and yields a completely continuous waveform. This playback FM signal is obtained via SW5 from IC107 pin 28.

Since the down converted color signal is included at this point, in one route, the signal goes to the color signal playback circuit. In another route, for demodulating the luminance signal, a highpass filter removes the low-band color signal. This filter possesses the same response as that for recording.

The signal also goes from IC107 pin 27 to the FM AGC circuit.

The FM AGC circuit is used for precisely driving the dropout compensator (DOC). Dropout refers to intermittent loss of signal due to imperfections in the tape. When this occurs, the DOC insert the signal from the previous horizontal scanning line, thereby minimizing visible effects in the picture.

From this point, the corrected signal goes from IC107 pin 22 to a highpass filter, which removes the low-band color signal. This filter possesses the same response as that for recording.

The FM equalizer amplifier compensates to obtain a flat output.

An emitter-follower converts the impedance of the signal, which then goes to the equalizer.
The equalizer possesses a maximum delay by 50 msec at the carrier frequency and reduces edge noise at the transition from black to white level.

An emitter-follower again converts the impedance of the signal, which then is branched in two directions. One goes to the double limiter circuit of IC106 pin 16. The double limiter possesses an approximately 80 dB limited gain for precisely driving the demodulator and also functions to prevent black/white reversal.

The limited FM signal waveform becomes a precise squarewave and enters the demodulator. The demodulator is a phase detecting type using a delay line. Through SW2, the resulting AM luminance signal goes from IC106 pin 24 to an emitter-follower, then to LPF, where it is integrated to become the demodulated video signal. In addition to functioning as an integrator, LPF reduces FM carrier leak and attenuates the band where the playback color signal is to be inserted.

L109 & C125 between Q108 and Q110 from a lowpass filter and LC functions as a color subcarrier frequency trap and selectively attenuate the central energy region of the color signal. EQ delays the luminance signal by about 600 nsec to match the timing of the color signal at the playback output. The combined characteristics of LPF and EQ improve the pulse response of the luminance signal.

The signal through EQ goes via an emitter-follower a broad band to an amplifier.

During recording, the drum flipflop signal is supplied to the frequency modulator, shifting the CH-2 track 1/2 Fh with respect to the CH-1 track. By this, during playback, the crosstalk component from the adjacent track becomes 1/2 line offset relative to the main signal.

In the playback mode, by employing the above relationship, together with the correlation between video signal lines *n* and *(n − 1)*, and the random nature of the noise component, the noise component becomes reduced and S/N improved.

As a consequence of including FM interleaving and noise canceller functions, the playback luminance signal is passed through a comb filter which possesses the luminance signal spectrum.

The signal through the equalizer goes to the equalizer amplifier, where the midband component is increased to improve picture sharpness and softness. This signal is sent through the subcarrier trap to pin 8 of IC101. R105 determines the luminance signal level during playback.

With a CCIR (PAL or SECAM) signal, noise reduction at the VIDEO SUB board employs horizontal correlation of the Y signal for suppressing noise.

The demodulated luminance signal is applied to VIDEO SUB board connector 16 and the 1H delayed FM signal to connector 11. The delayed FM signal goes to the limiter and demodulator at IC1 pin 2. A lowpass filter cuts the high frequency component (i.e., color signal) to yield the luminance signal. This is delayed by the equalizer and sent via R11, which adjusts the level, and an emitter-follower to IC1 pin 10.

At the same time, the luminance signal from which noise has been removed appears at pin 11. These are subtracted at the differential amplifier to yield the noise component, which is sent to the clip and highpass amplifier circuits.

After cutting the DC component of the noise, the result is inverted and mixed with the playback luminance signal. The luminance signal with attenuated noise appears at pin 16.

The noise canceller circuit attenuates the highband component of this signal, while the equalizer amplifier and de-emphasis circuits raise the midband component. The signal then goes via an emitter-follower and electronic switch to connector 21 of the Y & PRE/REC board.

R101 determines the signal level applied to IC101 pin 7. In this IC, an emitter-follower converts the impedance of the signal corresponding to the mode and supplies it to IC106 pin 12.

This circuit operates in the opposite manner as the non-linear pre-emphasis circuit for recording and increases the amount of de-emphasis as the signal level decreases. Another function of the main and non-linear de-emphasis circuits is to demodulate the clipped overshoot and undershoot components produced by the pre-emphasis circuits.

Excess de-emphasis can impair resolution. Therefore, the amount of de-emphasis is slightly less than the amount of pre-emphasis, after which the noise canceller reduces high frequency noise.

At the Y/C mixer circuit, the luminance signal from the noise limiter via SW3 and the squelch circuit is mixed with the playback color signal. This becomes the output of IC106 through SW5 and emitter-follower circuits.

The IC106 output goes from conn. 92 of the Y / PRE/REC board to conn. 42 of the VIDEO SUB board, where it is supplied to the video pulse equalizer circuit formed by IC101, Q101 and EQ.

The video pulse equalizers circuit serves to improve pulse response and reduce edge noise by introducing preshoot into regions of rapid transition from black to white level, and from white to black level.

During recording, since Q101 switches ON, the delay time of EQ is zero.

The output goes via conn. 52 to emitter-follower Q11 of the VIDEO CONTROL board.

This transistor normally functions as an emitter follower, but when the video mode select switch is set CH SET, it becomes cutoff by high applied to D4.

The clamp circuit formed by D13 and Q10 fixes the sync tip of the video signal, which is then branched into two lines. One of these goes through Q13 emitter-follower to VIDEO CONTROL board conn. 111, then to the camera connector output. The other output of the clamp circuit is supplied to Q9 emitter-follower.

VIDEO CONTROL board conn. 111 is the camera signal in/out terminal. It functions for video input during recording and video output during playback. In the playback mode, approximately 4.6 V DC is superimposed on the video output signal. These functions are obtained only when the REC SELECT switch is set to CAMERA.

Electronic switches Q12 and Q14 are on in the REC and E-E modes. Q12 functions to cut off the video signal, while Q14 terminate the camera signal at R56 (75 Ω).

The video signal from Q9 goes through R39 to color board conn. 215, then to the rear panel VIDEO OUT connector. The signal also goes through EQ1, and mixer Q7 and Q8 to conn. 241, then to the RF converter. EQ1 delays the lowband luminance signal by approximately 170 nsec.

IC4 video signal generator functions only when the video mode select switch is set to CH SET. This output is supplied to the RF converter.

3. Special circuit descriptions

1) Keyed AGC circuit

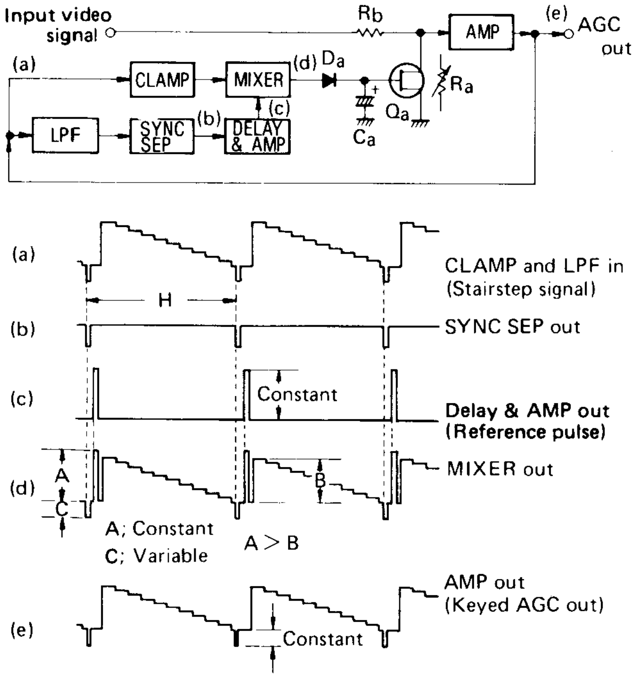

Input video signal
Rb
AMP
(e)
AGC out
(a)
CLAMP
MIXER
(d)
Da
Ra
Qa
Ca
LPF
SYNC SEP
(b)
(c)
DELAY & AMP
(a)
CLAMP and LPF in (Stairstep signal)
H
(b)
SYNC SEP out
(c)
Constant
Delay & AMP out (Reference pulse)
(d)
A
B
C
MIXER out
A; Constant
C; Variable
A > B
(e)
AMP out (Keyed AGC out)
Constant

Fig. 3-30 Keyed AGC principle

The AGC out signal appears at the clamp and LPF as waveform (a). Sync tip is clamped at a fixed DC potential and the signal is supplied to the mixer. Waveform (b) is obtained following sync separation through a lowpass filter. This is delayed to match the phase of the back porch of waveform (a) horizontal sync component, amplified to a fixed level and mixed to become waveform (c).

At the mixer, the H sync back porch is mixed at a fixed level which is slightly higher than the 100% video level, as indicated by waveform (d). Level of this added reference pulse is fixed and the signal is rectified by Da and Ca. The rectified voltage varies the impedance (Ra) between Qa drain and source. Level of the input video signal supplied to the amplifier becomes controlled by the ratio of Ra to Rb.

For example, when the input signal level is high, the sum of the sync and reference levels increases and the rectified output becomes larger. When applied to Qa gate, this larger voltage decreases the impedance Ra between Qa source and drain. As a result, the input level to the amplifier becomes attenuated by the ratio of Ra to Rb.

In the above manner, because of the fixed added pulse level, the rectified output becomes determined by the sync level. By this process, the keyed AGC circuit functions to maintain a fixed sync level.

An advantage of the keyed AGC circuit is that its output level does not vary with change in the average picture level (APL) of the input video signal. This permits use of the above mentioned non-linear pre-emphasis system.

2) Dropout compensator circuit

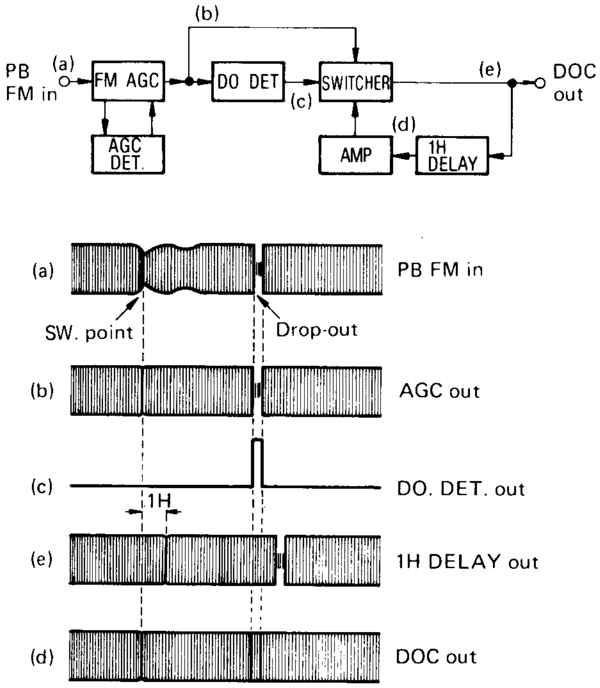

(b)
PB FM in
(a)
FM AGC
DO DET
SWITCHER
(e)
DOC out
(c)
AGC DET.
(d)
AMP
1H DELAY
(a)
PB FM in
SW. point
Drop-out
(b)
AGC out
(c)
DO. DET. out
1H
(e)
1H DELAY out
(d)
DOC out

Fig. 3-31 Dropout compensator

Detects in the tape, such as magnetic particle losses, can cause loss or reduction of the FM signal, which may impair picture quality. When this occurs, the dropout compensator functions to insert the FM signal from the previous horizontal line, thereby preventing visible effects in the picture.

The FM AGC circuit first corrects for level fluctuations in the playback FM signal, which arise from variations in head to tape contact at the intake and output of the rotating drum. This results in a fixed level as indicated by waveform (b) in Fig. 3-31.

Part of this output goes directly to the switching circuit, while another part is applied to the dropout detector. In the dropout detector circuit, a highpass filter cuts the low sideband of the FM signal and an integrator detects the dropout component. A precise squarewave is formed and supplied as waveform (c) to the switching circuit.

A 1H delay circuit and amplifier return part of this signal to the switching circuit as waveform (d). When (c) is low, output (b) is produced from the switcher. In event of dropout, (c) becomes high and output (d) is obtained. In this manner, the signal from the previous horizontal line becomes inserted in place of the dropout component. The loop circuit design of the DOC increases its effectiveness.

3) Double limiter circuit

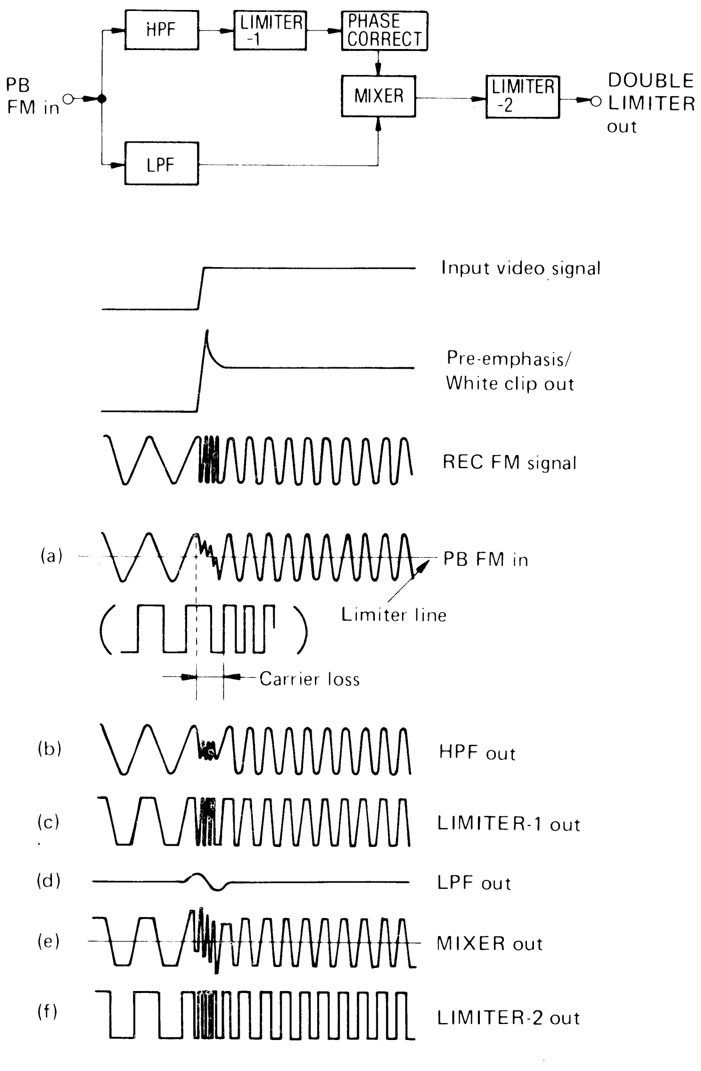

PB FM in
HPF
LIMITER -1
PHASE CORRECT
MIXER
LIMITER -2
DOUBLE LIMITER out
LPF
Input video signal
Pre-emphasis/ White clip out
REC FM signal
(a)
PB FM in
Limiter line
Carrier loss
(b)
HPF out
(c)
LIMITER-1 out
(d)
LPF out
(e)
MIXER out
(f)
LIMITER-2 out

Fig. 3-32 Double limiter principle

Overshoot can result when pre-emphasis is applied to a signal which varies from black to white level. The playback FM signal is indicated by waveform (a) in Fig. 3-32.

If limiting is applied at the limiter line at the center of the waveform excursion, it cannot correct the carrier loss component and black/white reversal and impaired S/N can occur. For this reason, the signal is applied to highpass and lowpass filters which separate the carrier and lower sideband components, as indicated by (b) and (d).

The signal through the highpass filter goes to Limiter-1 which applies approximately 10 dB limiter gain, then to the mixer. At the mixer, the signals from the HPF and LPF are mixed and sent to Limiter-2. This is shown by waveform (e).

Phases of the signals are aligned by the phase correct circuit. As can be noted from waveform (e) limiting can be applied to the lower sideband component without losing signal information.

With the double limiter, the noise component is not amplified, while the carrier and lower sideband ratio is corrected. This serves to eliminate carrier loss and prevent black/white reversal. As a result, adequate pre-emphasis can be applied for improved S/N at high frequency.

4) Demodulator circuit

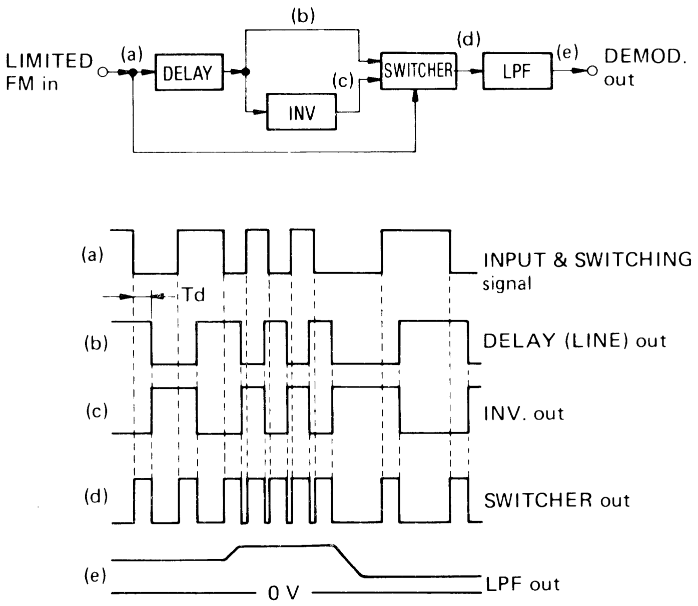

LIMITED FM in
(a)
DELAY
(b)
INV
(c)
SWITCHER
(d)
LPF
(e)
DEMOD. out
(a)
INPUT & SWITCHING signal
Td
(b)
DELAY (LINE) out
(c)
INV. out
(d)
SWITCHER out
(e)
0 V
LPF out

Fig. 3-33 Demodulator principle

Part of the signal from the limiter goes directly to the switching circuit as the switching pulse. In the other route the signal goes through a delay circuit, then to the switcher as waveform (b) in Fig. 3-33.

The delayed output through the inverter enters the switcher as waveform (c). Since the delay amount (Td) is 1/4th the FM carrier period of 4.3 MHz, it becomes approximately 0.058 μsec.

A low switching pulse (a) produces the switching circuit output shown by (b), while a high pulse results in (c). Consequently, the switching circuit output becomes as shown by waveform (d). This is integrated through a lowpass filter to yield the AM luminance signal indicated by (e).

In the block diagram, the delay amount is determined by C174 between pins 21 and 22 of IC106.

5) Noise limiter circuit

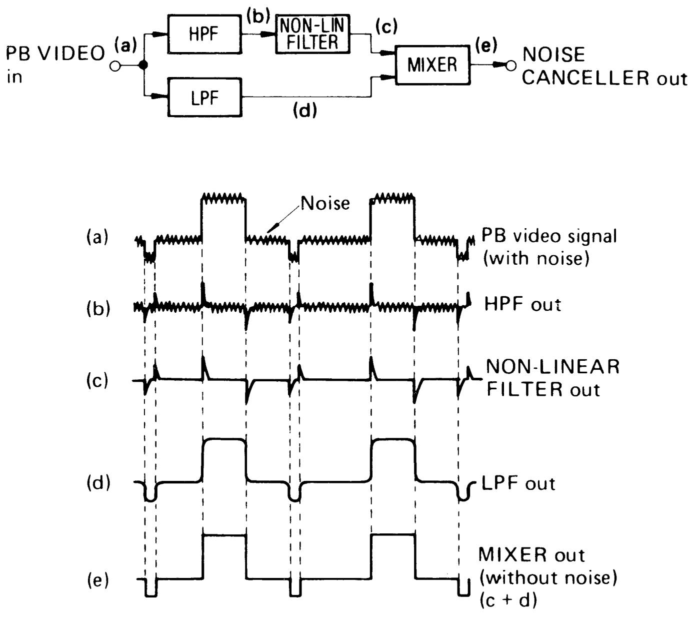
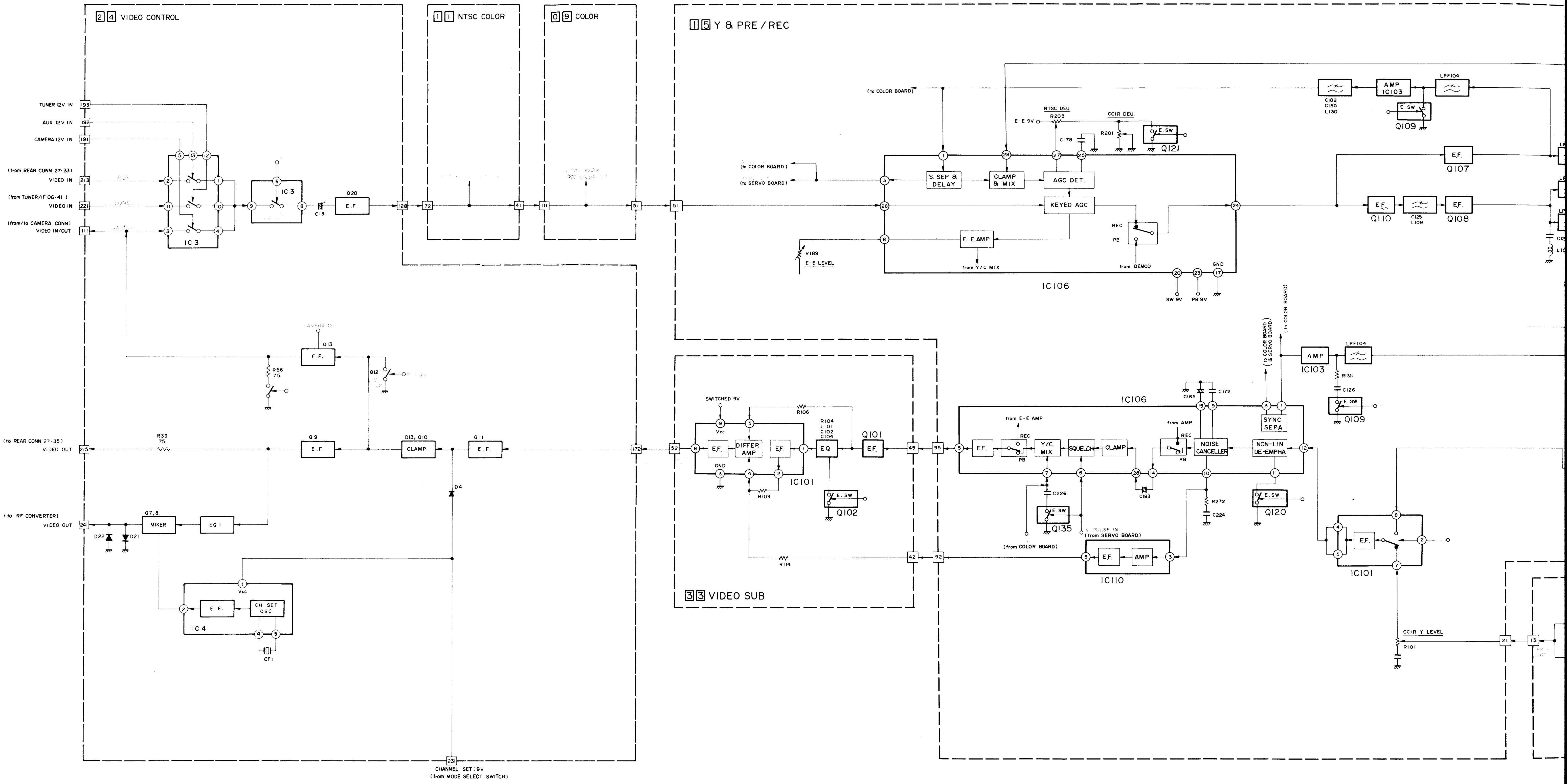

PB VIDEO in
(a)
HPF
(b)
NON-LIN FILTER
(c)
MIXER
(e)
NOISE CANCELLER out
LPF
(d)
Noise
(a)
PB video signal (with noise)
(b)
HPF out
(c)
NON-LINEAR FILTER out
(d)
LPF out
(e)
MIXER out (without noise) (c + d)

Fig. 3-34 Noise canceller principle

The signal played back from the tape contains FM noise at high frequencies, as indicated by (a) in Fig. 3-34. This is applied in two lines to highpass and lowpass filters to become waveforms (b) and (d).

Noise in the plateau section of the video signal, which may easily affect the picture, becomes concentrated in the low level portion of the signal through the highpass filter. The non-linear filter functions to remove this noise to produce waveform (c). Waveforms (c) and (d) are then mixed to yield noise free waveform (e).

By varying the mixer input level, contour clarity can be varied to produce the visual effect of improving resolution.


24 VIDEO CONTROL
11 NTSC COLOR
09 COLOR
15 Y & PRE / REC
33 VIDEO SUB
TUNER 12V IN
AUX 12V IN
CAMERA 12V IN
(from REAR CONN. 27-33) VIDEO IN
(from TUNER/IF 06-41) VIDEO IN
(from/to CAMERA CONN) VIDEO IN/OUT
(to REAR CONN. 27-35) VIDEO OUT
(to RF CONVERTER) VIDEO OUT
193
192
191
213
221
111
215
241
IC 3
Q20
E.F.
C13
128
72
41
111
51
51
Q13
R56 75
Q12
Q9
R39 75
D13, Q10
CLAMP
Q11
D4
Q7, 8
MIXER
EQ I
D22
D21
Vcc
E.F.
CH SET OSC
IC 4
CF1
172
231
CHANNEL SET : 9V
(from MODE SELECT SWITCH)
(to COLOR BOARD)
NTSC DEU.
R203
E-E 9V
CCIR DEU.
C178
R201
E. SW
Q121
(to COLOR BOARD)
(to SERVO BOARD)
S. SEP & DELAY
CLAMP & MIX
AGC DET.
KEYED AGC
E-E AMP
from Y/C MIX
REC
PB
from DEMOD
R189
E-E LEVEL
SW 9V
PB 9V
GND
IC106
C182
C185
L130
AMP IC103
LPF104
Q109
E.F.
Q107
Q110
C125
L109
Q108
SWITCHED 9V
R106
R104
L101
C102
C104
Q101
DIFFER AMP
EQ
GND
IC101
R109
Q102
R114
52
45
95
42
92
(to COLOR BOARD)
(to COLOR BOARD & SERVO BOARD)
AMP
IC103
LPF104
R135
C126
Q109
C165
C172
IC106
from E-E AMP
from AMP
Y/C MIX
SQUELCH
CLAMP
NOISE CANCELLER
SYNC SEPA
NON-LIN DE-EMPHA
C226
Q135
C183
R272
C224
Q120
PULSE IN (from SERVO BOARD)
(from COLOR BOARD)
AMP
IC110
IC101
CCIR Y LEVEL
R101
21
13

Fig

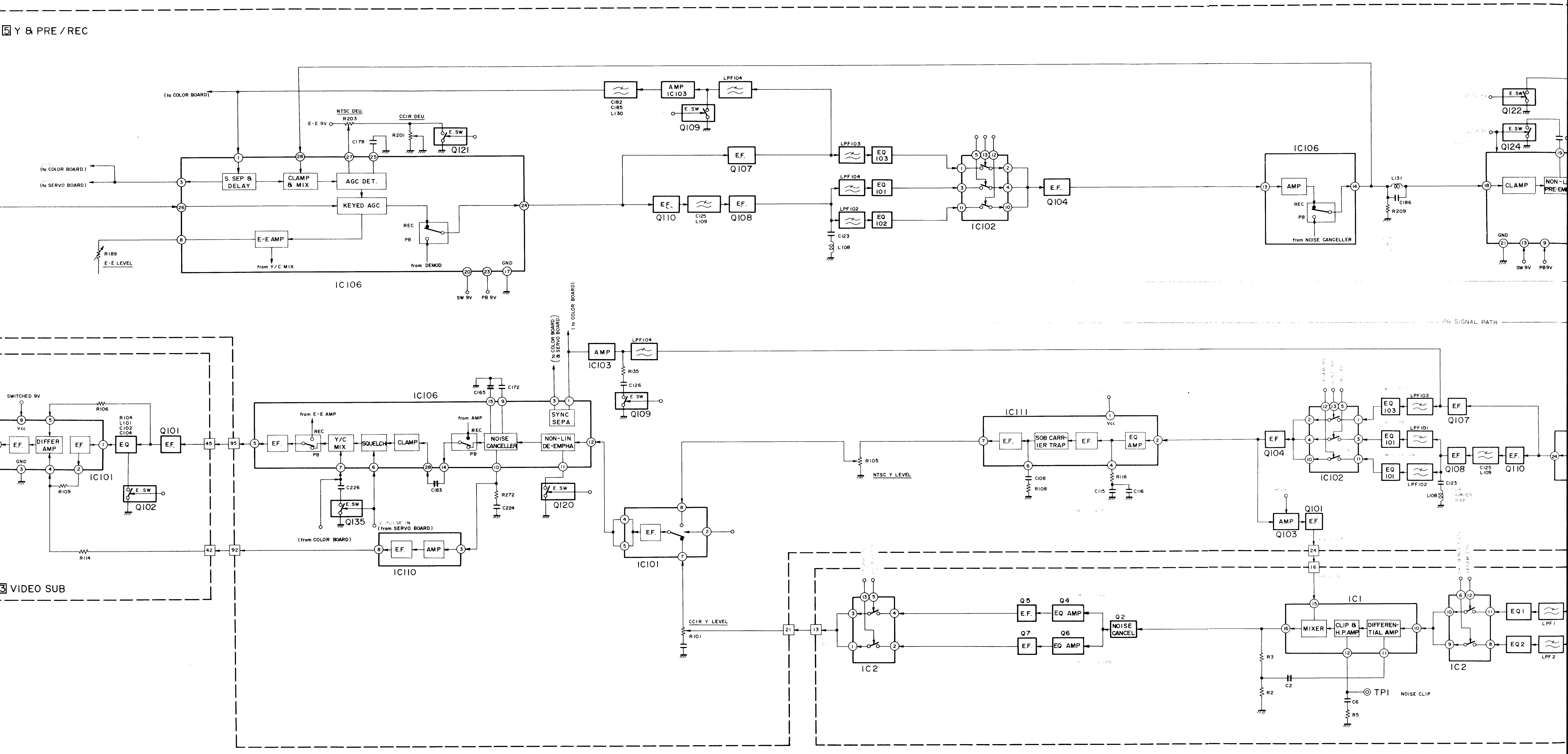
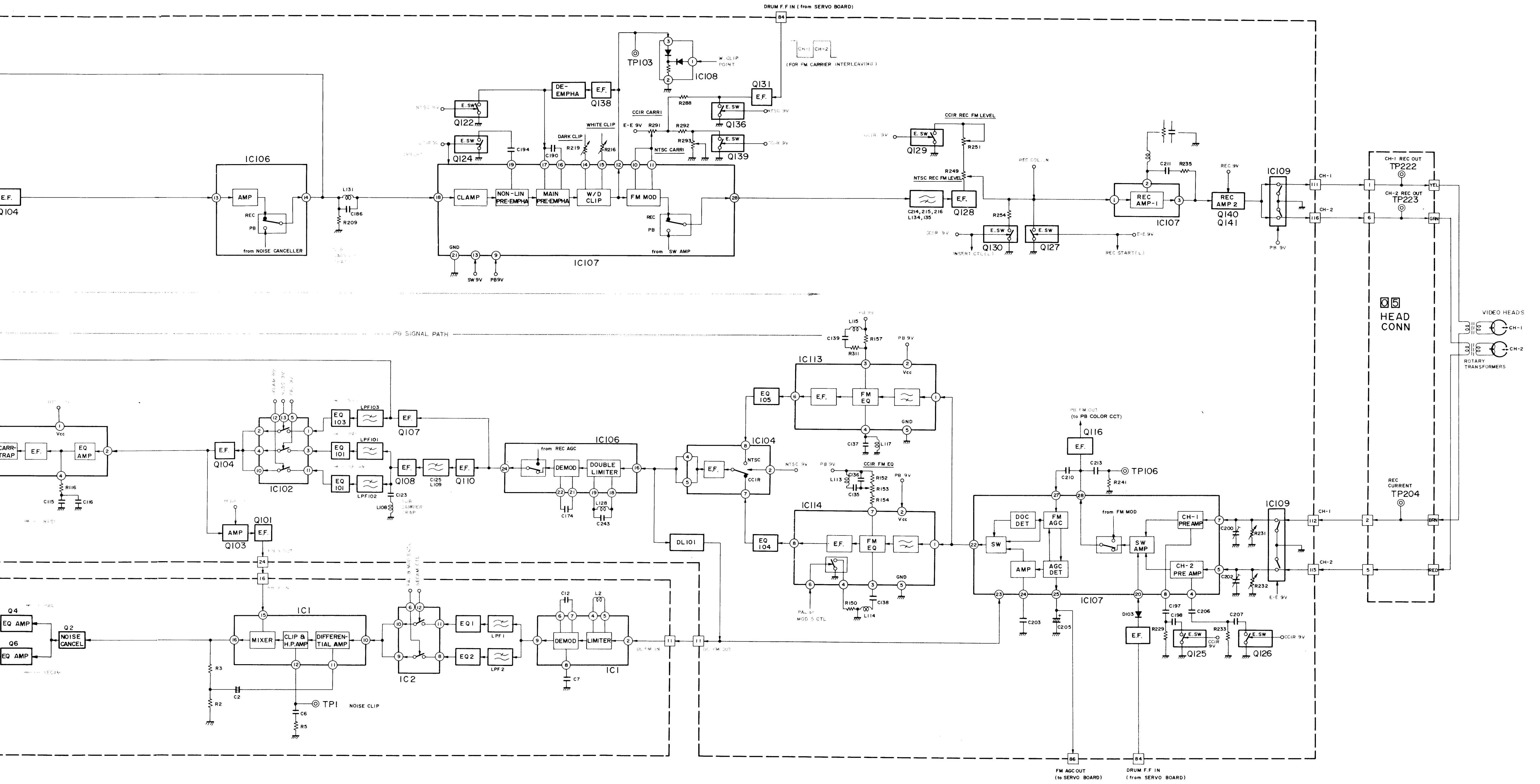

5 Y & PRE / REC
(to COLOR BOARD)
(to COLOR BOARD)
(to SERVO BOARD)
NTSC DEU.
R203
CCIR DEU.
E-E 9V
C178
R201
E. SW
Q121
S. SEP & DELAY
CLAMP & MIX
AGC DET.
KEYED AGC
E-E AMP
REC
PB
from Y/C MIX
from DEMOD
R189
E-E LEVEL
GND
SW 9V
PB 9V
IC106
C182
C185
L130
AMP IC103
LPF104
E. SW
Q109
E.F.
Q107
E.F.
Q110
C125
L109
E.F.
Q108
LPF103
EQ 103
LPF104
EQ 101
LPF102
EQ 102
C123
L108
IC102
E.F.
Q104
IC106
AMP
REC
PB
from NOISE CANCELLER
L131
C186
R209
CLAMP
NON-LIN PRE-EMP
E. SW
Q122
E. SW
Q124
GND
SW 9V
PB9V
PB SIGNAL PATH
3 VIDEO SUB
SWITCHED 9V
R106
Vcc
E.F.
DIFFER AMP
E.F.
GND
R109
R114
IC101
R104
L101
C102
C104
EQ
Q101
E.F.
E. SW
Q102
45
95
42
92
(to COLOR BOARD) (& SERVO BOARD)
(to COLOR BOARD)
C165
C172
IC106
from E-E AMP
REC
PB
E.F.
Y/C MIX
SQUELCH
CLAMP
from AMP
REC
PB
NOISE CANCELLER
SYNC SEPA
NON-LIN DE-EMPHA
C226
E.SW
Q135
C183
R272
C224
E. SW
Q120
V. PULSE IN (from SERVO BOARD)
(from COLOR BOARD)
E.F.
AMP
IC110
AMP
IC103
LPF104
R135
C126
E. SW
Q109
E.F.
IC101
CCIR Y LEVEL
R101
R105
NTSC Y LEVEL
IC111
Vcc
E.F.
SOB CARRIER TRAP
E.F.
EQ AMP
C108
R108
R116
C115
C116
E.F.
Q104
IC102
EQ 103
LPF103
EQ 101
LPF101
EQ 101
LPF102
E.F.
Q107
E.F.
Q108
C125
L109
E.F.
Q110
C123
L108
AMP
Q103
Q101
E.F.
24
16
21
13
IC2
Q5
E.F.
Q4
EQ AMP
Q7
E.F.
Q6
EQ AMP
Q2
NOISE CANCEL
IC1
MIXER
CLIP & H.P.AMP
DIFFERENTIAL AMP
R3
C2
R2
TP1
NOISE CLIP
C6
R5
IC2
EQ1
LPF1
EQ2
LPF2

Fig. 3-35 Luminance signal block diagram


DRUM F.F IN (from SERVO BOARD)
84
CH-1
CH-2
(FOR FM CARRIER INTERLEAVING)
TP103
W. CLIP POINT
IC108
Q131
E.F.
DE-EMPHA
E.F.
Q138
R288
E.SW
Q136
NTSC 9V
E.SW
Q122
E.SW
Q124
C194
C190
DARK CLIP
R219
WHITE CLIP
R216
CCIR CARRI
E-E 9V
R291
R292
R293
NTSC CARRI
E.SW
Q139
IC106
AMP
REC
PB
from NOISE CANCELLER
E.F.
Q104
L131
C186
R209
CLAMP
NON-LIN PRE-EMPHA
MAIN PRE-EMPHA
W/D CLIP
FM MOD
REC
PB
from SW AMP
GND
SW 9V
PB9V
IC107
CCIR REC FM LEVEL
E.SW
Q129
R251
R249
NTSC REC FM LEVEL
C214, 215, 216
L134, 135
E.F.
Q128
REC COL IN
R254
E.SW
Q130
E.SW
Q127
E-E 9V
INSERT CTL
REC START (L)
C211
R235
REC AMP-1
IC107
REC 9V
REC AMP 2
Q140
Q141
IC109
PB 9V
CH-1
CH-2
CH-1 REC OUT
TP222
CH-2 REC OUT
TP223
YEL
GRN
05
HEAD CONN
VIDEO HEADS
CH-1
CH-2
ROTARY TRANSFORMERS
PB SIGNAL PATH
L115
C139
R157
R311
PB 9V
IC113
Vcc
EQ 105
E.F.
FM EQ
GND
C137
L117
IC104
NTSC
NTSC 9V
CCIR
E.F.
CCIR FM EQ
L113
C136
C135
R152
R153
R154
IC114
EQ 104
E.F.
FM EQ
GND
PAL or MOD 5 CTL
R150
L114
C138
Vcc
CARR-TRAP
E.F.
EQ AMP
Vcc
R116
C115
C116
IC102
EQ 103
LPF103
EQ 101
LPF101
EQ 101
LPF102
E.F.
Q107
E.F.
Q108
C125
L109
E.F.
Q110
C123
L108
IC106
from REC AGC
DEMOD
DOUBLE LIMITER
C174
L128
C243
Q104
E.F.
AMP
E.F.
Q103
Q101
DL101
PB FM OUT
(to PB COLOR CCT)
Q116
E.F.
C210
C213
TP106
R241
DOC DET
FM AGC
from FM MOD
CH-1 PRE AMP
SW
SW AMP
AMP
AGC DET
CH-2 PRE AMP
IC107
C200
R231
C202
R232
E-E 9V
IC109
CH-1
CH-2
REC CURRENT
TP204
BRN
RED
C203
C205
D103
C197
C198
C206
C207
E.F.
R229
E.SW
CCIR 9V
Q125
R233
E.SW
CCIR 9V
Q126
86
FM AGC OUT
(to SERVO BOARD)
84
DRUM F.F IN
(from SERVO BOARD)
Q4
EQ AMP
Q6
EQ AMP
Q2
NOISE CANCEL
R3
R2
C2
IC1
MIXER
CLIP & H.P.AMP
DIFFEREN-TIAL AMP
C6
R5
TP1
NOISE CLIP
IC2
EQ1
LPF1
EQ2
LPF2
C12
L2
DEMOD
LIMITER
C7
IC1
24
16
11
11

m

3.3.4 NTSC color signal

1. Recording system

The color TV signal selected at the input switching IC and IC3 is supplied to E. SW (Q403). Q403 is set to ON during recording, so that the input video signal is sent to the band-pass filter BPF402, where only the color signal component with its energy centered on the color subcarrier (3.579545 MHz) is extracted, while the unnecessary luminance signal component is removed. In addition, Q403 functions to do the switching of REC/PB of IC401 and, when IC401 pin 22 becomes more than 6 V or Q403 is set to ON, IC401 becomes the REC mode. The color signal component passing through BPF402 goes from IC401 pin 4 to the ACC AMP. The ACC (Automatic Color Control) functions to control the output level to maintain the output burst level constant with the output branching off into two directions. One is supplied to the ACC DET, APC DET and KILLER DET. The ACC DET operates to extract the burst signal by means of the burst gate pulse from the burst gate pulse generation circuit, maintaining the ACC AMP at this level. The other signal is sent to the circuit block which comprises the MAIN CONVERTER, BURST EMPHASIS and KILLER AMP. In addition to the ACC AMP output, the subconverter output, KILLER DET output and burst gate pulse are also supplied to this circuit block, where the color signal of 3.58 MHz from the ACC AMP is frequency converted into 40 fH by means of the converter output of 4.21 MHz (3.58 MHz + 40 fH) and then converted into the signal with only the burst increased by 6 dB.

When the input signal is a black/white signal, the circuit block output is set to OFF by means of the signal from the KILLER DET. The low band converted color signal which is output from IC401 pin 1 is sent to LPF401, where the extra component other than the 40 fH component is removed. After the color signal recording current is adjusted at R452 (REC COL. LEV.), it is mixed with the FM of the luminance signal and then the FM signal of the high frequency and high level is recorded on the tape as AC bias. This is mixed with the luminance signal through E.F. (Q405) and then recorded on the tape.

The SUB CONV. functions to convert the frequency by means of 40 fH (629 kHz) from the AFC loop and Fs (3.58 MHz) from the APC loop. Because the SUB CONV. output contains the signal component of sum and difference, the sum component of 4.21 MHz (Fs + 40 fH) is extracted at the band-pass filter BPF401 and sent to the MAIN CONV.

2. AFC (Automatic Frequency Control)

The AFC Loop performs the following functions:

1) Generation of the 40 fH signal (40 x 15.734 kHz ≒ 629 kHz),
2) To shift the 40 fH signal phase by 90° every 1H, and
3) Phase correction of the horizontal sync signal.

The input video signal is sync separated at the sync signal separator circuit within IC106 and the horizontal sync signal is sent from pin 3 of IC106 to pin 6 of IC401. The horizontal sync signal containing only H with the 1/2H sync signal of V sync signal portion cut off at the 1/2H PULSE KILLER is sent to the burst gate pulse generator circuit as well as the phase shift circuit and AFC detector circuit.

The latter circuit is a phase comparison circuit of the AFC Loop and the reference signal is a horizontal sync signal, while the comparison signal is an fH signal of 1/160 count-down of the 160 fH VCO (Voltage Controlled Oscillator) output. The error output from the AFC detector circuit is supplied to the 160 fH VCO and the VCO oscillates at 160 fH (160 x 15.734 kHz). The 160 fH signal is sent to both the 1/4 and 1/160 count-down circuits. The signal counted down to 1/160 becomes fH, which is phase compared with the horizontal sync signal of the input video signal at the AFC detector circuit. Since the reference horizontal sync signal is constant, the error output also becomes constant and the 160 fH VC is so arranged at R230 (AFC) to oscillate exactly at 160 fH. The 160 fH signal sent to the 1/4 count-down circuit is converted into 40 fH and then fed to the phase shift circuit, to which the drum flip-flop signal and H sync signal are also supplied. The output from the phase shift circuit is 40 fH. The phase of the signal to be recorded at the CH-1 head every 1H gains by 90°, while that of the CH-2 head signal inversely loses by 90°. This 40 fH signal is sent to the sub-converter circuit as the AFC output.

3. APC (Automatic Phase Control)

The ACC AMP output is also sent to the APC detector circuit. This detector circuit comprises a phase comparison circuit of the APC Loop, which functions to perform the phase comparison of the reference signal, ACC output burst signal, with the 3.58 MHz VCO output which produces the comparison signal by means of the burst gate pulse. The error voltage is added to the 3.58 MHz VCO, which generates a signal of 3.58 MHz condordant with the input color signal phase and feed it to the sub-converter.

4. Playback system

The PB signal played back from the video head is amplified and switched at IC107 of the Y & PRE/REC board. IC107 operates in the same manner as the luminance signal playback system.

The FM signal amplified at IC107 is supplied from pin 28 to the luminance signal playback system, while it is also sent from CONN. 141 to CONN. 11 of the P.B. CHROMA AMP board and then supplied via the bias trap L2, C2 to the low-pass filter LPF2. This bias trap functions to prevent the erase head signal during audio dubbing from being mixed with the color signal playback system.

LPF2 attenuates the unnecessary luminance signal component and extracts only the low band color signal, which is supplied to the amplifier made up of IC2 after the timing with the playback system luminance signal is matched at the equalizer IC2.

After this, the playback color signal is sent from IC401 pin 24 to the main converter. Since the 3.58 MHz + 40 fH signal is sent from the sub-converter to the main converter as is the same with recording, the output is restored to the original 3.58 MHz color signal.

The actual played back signal contains time axis variations (frequency and phase variations) due to changes in the tape speed, rotation irregularities of the video head and expansion and contraction of the tape. This means that when the played back low band conversion color burst signal is Fsc', it is played back as Fsc' = 40 fH' ± Δf. Here fH' represents fH ± ΔH, i.e. frequency variations due to changes in the tape speed, etc. It is the frequency DISCRI circuit consisting of a block, including the GATE circuit, COUNT-DOWN circuit and DECODER DET. that functions to correct such a big variation as 40 fH'. (Description of the frequency DISCRI circuit will be made later.)

A small variation like ± Δf caused by rotation irregularities of the video head and expansion and contraction of the tape is corrected at the APC Loop. In the normal playback condition, frequency and phase variation are corrected at the APC Loop alone. The frequency DISCRI circuit operates only when the frequency variation exceeds the APC Lock range, bringing it back quickly within the range.

These correction signals control the 160 fH VCO to let it oscillate at 160 fH' ± 4Δf. This output is counted down to 1/4 and converted into 40 fH' ± Δf and then sent to the phase shift circuit. Here, as is the same with recording, the phase is advanced by 90° every 1H for the CH-1 playback, while it is delayed by 90° for the CH-2 playback. The resultant output is then sent to the sub-converter. Since a constant signal of 3.58 MHz is sent to the sub-converter from the 3.58 MHz VCO, the sub-converter output becomes (3.58 MHz + 40 fH' ± Δf) and (3.58 MHz − 40 fH' ∓ Δf). The band-pass filter BPF extracts (3.58 MHz + 40 fH ± Δf) component from the sub-converter output and sends it to the main converter. Therefore, the main converter output is the sum and difference component of the playback color signal 40 fH' ± Δf and BPF401 output (3.58 MHz + 40 fH' ± Δf), which produces a color signal without the difference component 3.58 MHz, i.e. variation. The resultant playback color signal is then sent to the ACC AMP. The ACC AMP output becomes a constant burst level, thereby cancelling the color crosstalk at DL401.

The output from DL401 is branched off into two directions: one is supplied as a comparison signal to the ACC detector circuit, APC detector circuit and KILLER detector circuit, while the other is restored to the original burst level by lowering the 6 dB up converted burst signal level by 6 dB at the BURST DE-EMPHASIS circuit. This block also performs the KILLER operation by means of the KILLER detector circuit output.

The color signal output from IC401 pin 20 is sent to IC106 pin 7 after the leakage of the unnecessary sum component (3.58 MHz + 80 fH) out of the main converter output is attenuated at the TRAP circuit of L402. C402 and the playback color level is adjusted at R700. This signal is mixed with the luminance signal at the Y/C MIX circuit, thereby becoming a playback video signal.

After this point, the signal flow is the same as the luminance signal playback system.

5. Frequency DISCRI circuit

Fig. 3-36 shows a block diagram and properties of the frequency DISCRI (discriminator) circuit. The frequency DISCRI circuit counts the output from the 160 fH VCO and sents the signal by which to control the 160 fH VCO when the frequency deviates more than ±1/2 fH. Actually, it counts the 160 fH VCO output for the 4H period and 160 fH is equivalent to 640 pulse with 1/2 fH corresponding to 2 pulse. The 160 fH VCO output is sent to the COUNTER circuit only for the 4H period at Gate 1. A gate pulse of 4H is supplied from the 1/8 dividing circuit go Gate 1. The pulse number during this 4H period becomes 630 ± n. The COUNTER circuit counts the pulse during this period and sends two kinds of signals. One sends an output, whose polarity changes depending upon if the pulse number is more or less than 640, to the DECODER circuit, while the other sends to Gate 2, a gate pulse of High at the time of 640 ± 2 (638 −642) and that of Low at other times.
When gate pulse from the COUNTER circuit is Low, Gate 2 supplies the pulse from the 1/8 dividing circuit to the DECODER circuit, which means that the DECODER circuit functions only for the 1H period every 8H.

Therefore, as is shown in Fig. 3-36, the DECODER output supplies three different outputs: a zero output when the pulse number is 640 ± 2 (i.e. 160 ± 1/2 fH), an output by which to increase the oscillation frequency when it is less than 638 (i.e. 159.5 fH) and an output by which to decrease the oscillation frequency when it is more than 642 (i.e. 160.5 fH). The portion of a zero output is corrected at the ALC Loop.

6. APC circuit

To the phase comparison circuit, a crystal oscillator output of 3.58 MHz as the reference signal and a playback color signal containing phase variations as the comparison signal are being supplied. The error voltage is sent to the 160 fH VCO and collaborates with the frequency DISCRI output to control the 160 fH VCO.

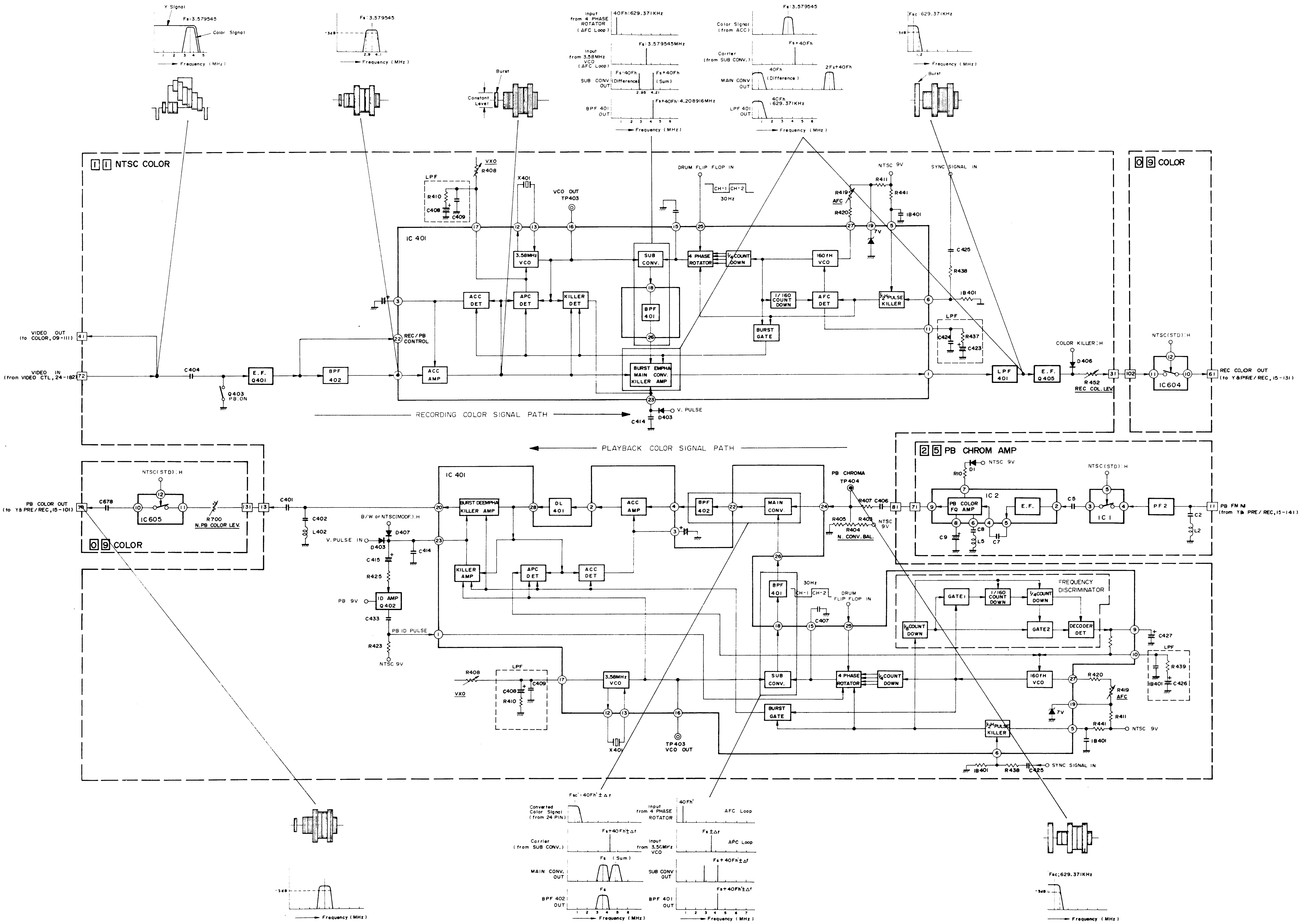
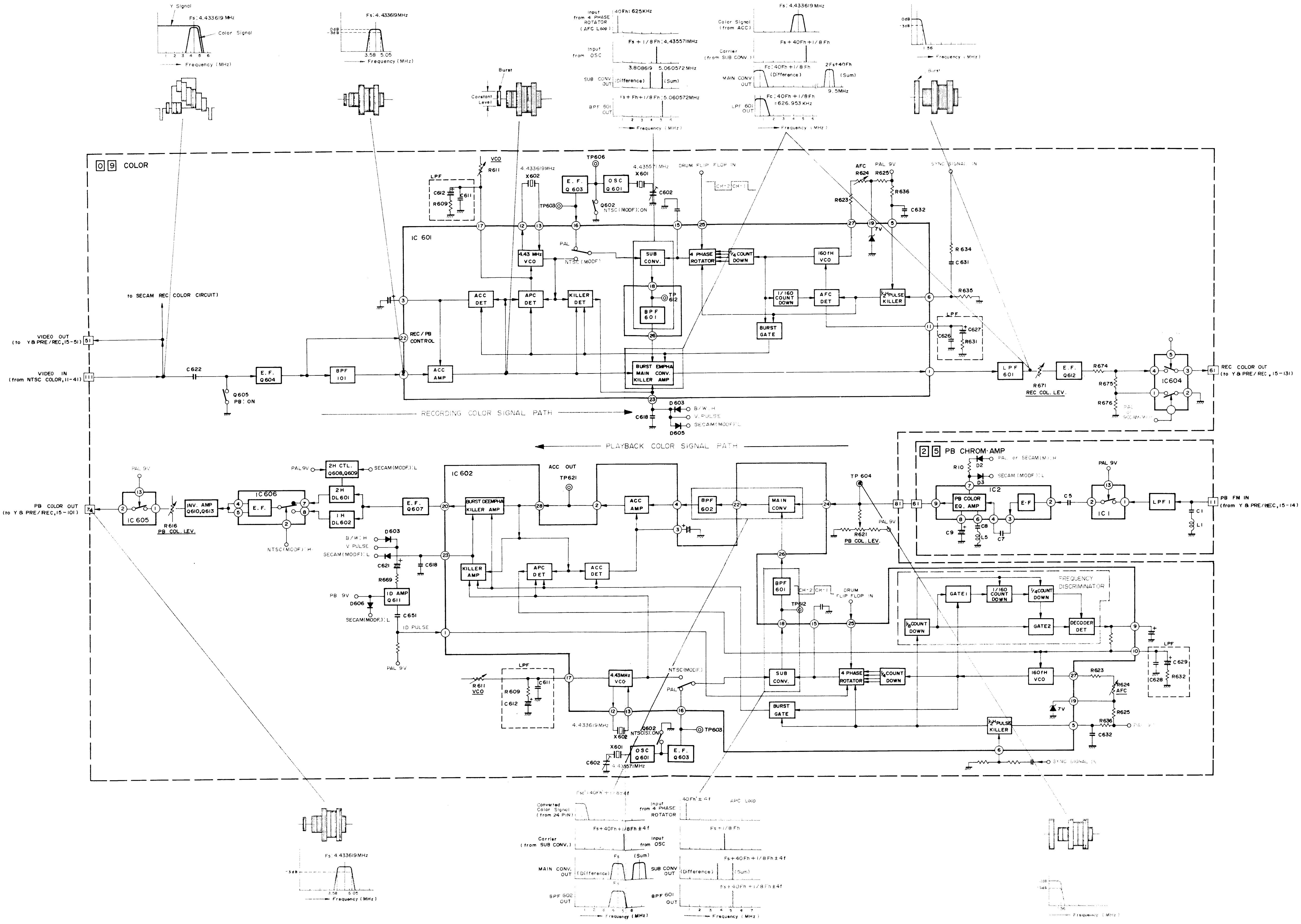

Y Signal
Fs:3.579545
Color Signal
Frequency (MHz)
-3dB
Burst
Constant Level
Input from 4 PHASE ROTATOR (AFC Loop)
40Fh:629.371KHz
Input from 3.58MHz VCO (AFC Loop)
Fs:3.579545MHz
SUB CONV OUT
Fs-40Fh (Difference)
Fs+40Fh (Sum)
BPF 401 OUT
Fs+40Fh:4.208916MHz
Color Signal (from ACC)
Carrier (from SUB CONV.)
Fs+40Fh
MAIN CONV OUT
40Fh (Difference)
2Fs+40Fh
LPF 401 OUT
40Fh :629.371KHz
Fsc:629.371KHz
11 NTSC COLOR
09 COLOR
IC 401
LPF
R410
C408
C409
VXO
R408
X401
VCO OUT
TP403
DRUM FLIP FLOP IN
CH-1
CH-2
30Hz
NTSC 9V
SYNC SIGNAL IN
R411
R419
AFC
R420
R441
IB401
7V
3.58MHz VCO
SUB CONV.
4 PHASE ROTATOR
1/4 COUNT DOWN
160fH VCO
ACC DET
APC DET
KILLER DET
BPF 401
1/160 COUNT DOWN
AFC DET
1/2H PULSE KILLER
C425
R438
BURST GATE
C424
R437
C423
REC/PB CONTROL
VIDEO OUT (to COLOR, 09-111)
VIDEO IN (from VIDEO CTL, 24-182)
C404
E.F. Q401
BPF 402
ACC AMP
Q403 PB:ON
BURST EMPHA MAIN CONV. KILLER AMP
V. PULSE
C414
D403
RECORDING COLOR SIGNAL PATH
COLOR KILLER:H
D406
LPF 401
E.F. Q405
R452
REC COL. LEV
NTSC(STD):H
IC604
REC COLOR OUT (to Y&PRE/REC, 15-131)
PLAYBACK COLOR SIGNAL PATH
25 PB CHROM AMP
PB COLOR OUT (to Y& PRE/REC, 15-101)
C678
IC605
R700
N.PB COLOR LEV.
C401
C402
L402
B/W or NTSC(MODE):H
V. PULSE IN
D407
C415
R425
PB 9V
ID AMP Q402
C433
PB ID PULSE
R423
NTSC 9V
BURST DEEMPHA KILLER AMP
DL 401
ACC AMP
BPF 402
MAIN CONV.
PB CHROMA
TP404
R407
C406
R405
R404
R403
N. CONV. BAL.
KILLER AMP
APC DET
ACC DET
BPF 401
30Hz
DRUM FLIP FLOP IN
C407
D1
R10
IC 2
PB COLOR FQ AMP
E.F.
C5
IC1
PF 2
PB FM IN (from Y& PRE/REC, 15-141)
C2
L2
C9
C8
L5
C7
FREQUENCY DISCRIMINATOR
GATE1
1/160 COUNT DOWN
1/4 COUNT DOWN
1/8 COUNT DOWN
GATE2
DECODER DET
C427
LPF
R439
IB401
C426
VXO
3.58MHz VCO
SUB CONV.
4 PHASE ROTATOR
1/4 COUNT DOWN
160fH VCO
BURST GATE
1/2H PULSE KILLER
X401
TP403 VCO OUT
R420
R419
AFC
R411
R441
NTSC 9V
IB401
R438
C425
SYNC SIGNAL IN
Fsc':40Fh'±Δf
Converted Color Signal (from 24 PIN)
Carrier (from SUB CONV.)
Fs+40Fh'±Δf
MAIN CONV. OUT
Fs (Sum)
BPF 402 OUT
Fs
Input from 4 PHASE ROTATOR
40Fh'
AFC Loop
Input from 3.58MHz VCO
Fs±Δf
APC Loop
SUB CONV OUT
Fs+40Fh'±Δf
BPF 401 OUT
Fsc;629.371KHz
Frequency (MHz)

Fig. 3-36 NTSC color signal block diagram



Y Signal
Fs: 4.433619 MHz
Color Signal
Frequency (MHz)
0dB
-3dB
3.58
5.05
Burst
Constant Level
Input from 4 PHASE ROTATOR (AFC Loop)
40Fh: 625KHz
Fs + 1/8 Fh: 4.435571MHz
Input from OSC
3.808619
5.060572 MHz
SUB CONV OUT
(Difference)
(Sum)
Fs + Fh + 1/8 Fh: 5.060572MHz
BPF 601 OUT
Color Signal (from ACC)
Fs + 40Fh + 1/8 Fh
Carrier (from SUB CONV.)
Fc: 40Fh + 1/8 Fh
2Fs+40Fh
MAIN CONV OUT
9.5MHz
Fc: 40Fh + 1/8 Fh
≒626.953 KHz
LPF 601 OUT
1.56
09 COLOR
VCO
R611
4.433619MHz
X602
LPF
C612
C611
R609
TP606
E.F. Q603
OSC Q601
4.435571MHz
X601
C602
TP603
Q602 NTSC(MODF): ON
DRUM FLIP FLOP IN
CH-2 CH-1
AFC
R624
PAL 9V
R625
R623
R636
C632
SYNC SIGNAL IN
IC 601
PAL
NTSC(MODF)
4.43 MHz VCO
SUB CONV.
4 PHASE ROTATOR
1/4 COUNT DOWN
160 fH VCO
7V
R634
C631
R635
to SECAM REC COLOR CIRCUIT
ACC DET
APC DET
KILLER DET
TP 612
BPF 601
1/160 COUNT DOWN
AFC DET
1/2H PULSE KILLER
REC/PB CONTROL
BURST GATE
LPF
C626
C627
R631
VIDEO OUT (to Y & PRE/REC, 15-51)
VIDEO IN (from NTSC COLOR, 11-41)
C622
E.F. Q604
BPF 101
ACC AMP
BURST EMPHA MAIN CONV. KILLER AMP
Q605 PB: ON
LPF 601
R671 REC COL. LEV.
E.F. Q612
R674
R675
R676
IC604
REC COLOR OUT (to Y & PRE/REC, 15-131)
D603
B/W: H
V. PULSE
SECAM(MODF): L
C618
D605
RECORDING COLOR SIGNAL PATH
PLAYBACK COLOR SIGNAL PATH
PAL 9V
2H CTL. Q608,Q609
SECAM(MODF): L
IC 602
ACC OUT
TP621
PB COLOR OUT (to Y & PRE/REC, 15-101)
IC 605
R616 PB COL. LEV.
INV. AMP Q610,Q613
IC606
E.F.
2H DL601
1H DL602
NTSC(MODF): H
E.F. Q607
BURST DEEMPHA KILLER AMP
ACC AMP
BPF 602
MAIN CONV
TP 604
R621 PB COL. LEV.
25 PB CHROM·AMP
PAL or SECAM(M): H
D2
R10
SECAM(MODF): L
D3
IC2
PB COLOR EQ. AMP
E-F
C5
C9
C8
L5
C7
IC 1
LPF 1
C1
L1
PB FM IN (from Y & PRE/REC, 15-14)
D603
B/W: H
V. PULSE
SECAM(MODF): L
C621
C618
KILLER AMP
APC DET
ACC DET
R669
PB 9V
D606
ID AMP Q611
SECAM(MODF): L
C651
ID PULSE
PAL 9V
BPF 601
CH-2 CH-1
DRUM FLIP FLOP IN
TP612
FREQUENCY DISCRIMINATOR
GATE1
1/160 COUNT DOWN
1/4 COUNT DOWN
1/8 COUNT DOWN
GATE2
DECODER DET
LPF
C629
R632
C628
NTSC(MODF)
R611 VCO
LPF
R609
C611
C612
4.43MHz VCO
PAL
SUB CONV.
4 PHASE ROTATOR
1/4 COUNT DOWN
160fH VCO
R623
R624 AFC
7V
R625
R636
PAL 9V
BURST GATE
1/2H PULSE KILLER
C632
SYNC SIGNAL IN
4.433619MHz
X602
Q602 NTSC(S): ON
TP603
X601
OSC Q601
E.F. Q603
C602
4.435571MHz
Fs 4.433619MHz
-3dB
3.58
5.05
Frequency (MHz)
Fsc': 40Fh' + 1/8 ± 4f
Converted Color Signal (from 24 PIN)
Fs + 40Fh + 1/8Fh ± 4f
Carrier (from SUB CONV.)
Fs
(Sum)
MAIN CONV. OUT
(Difference)
BPF 602 OUT
Frequency (MHz)
40Fh' ± 4f
APC Loop
Input from 4 PHASE ROTATOR
Fs + 1/8 Fh
Input from OSC
Fs + 40Fh + 1/8 Fh ± 4f
SUB CONV OUT
(Difference)
(Sum)
Fs + 40Fh + 1/8 Fh ± 4f
BPF 601 OUT
Frequency (MHz)
0dB
-3dB
1.56
Frequency (MHz)

Fig. 3-37 PAL color signal block diagram

3.3.5 PAL color signal system

The main circuits functions in the PAL color signal system are the same as those in the NTSC system. Therefore, only the differing points are outlined below.

1. The down converted subcarrier frequency is selected for (40 + 1/8) Fh, and oscillators are contained for Fs and Fs + 1/8 Fh (4.433619 MHz and 4.435572 MHz, respectively).

   The Fs oscillator output is employed by the color killer and APC circuits. The Fs + 1/8 Fh oscillator is required in order to obtain the (40 + 1/8) Fh down converted subcarrier frequency. Frequency spectra of the various components are indicated in Fig. 3-38.

2. During recording, the phase of only the CH-2 track color carrier signal is shifted −90° every 1H. The drum flip-flop signal is employed for distinguishing between the CH-1 and CH-2 tracks.

   When potential between 0 and 1.0 V appears at pin 25 of IC201, CH-1 is determined and the 40 Fh phase is shifted +90°. Appearance of between 2.5 and 5.5 V signifies CH-2, and the 40 Fh phase is shifted −90° every 1H. When the input current is between 0.97 and 1.50 mA, the phase is not shifted. Drum flipflop switching is performed by IC603.

   During playback, the VCO frequency is 4.43 MHz, while the color carrier frequency for NTSC (modified is 4.43 MHz) and NTSC (standard) is 3.58 MHz.

   In SECAM (modified) operation, the color carrier frequency is simply converted to lowband and recorded, using the PAL system converter circuit, and without countdown.

   In the playback mode, field correlation of the recorded tape pattern is utilized for reducing crosstalk. At this time, Q609 is off and Q608 on, cutting off the 2H delay line circuit.

3. SECAM detector

   As described earlier, the color signal circuit of this model is basically designed for recording a PAL color TV signal. A down converted, phase shifted direct recording system is used for PAL.

   Models specifically designed for SECAM generally employ a 1/4 countdown direct recording system. However, this model records the SECAM signal by using the down converted system.

   In this process, the SECAM signal is frequency modulated and sent through a bell filter. Since no effect is imparted on the phase error, the phase shift system for PAL recording becomes meaningless, and the signal is simply converted to lowband and recorded.

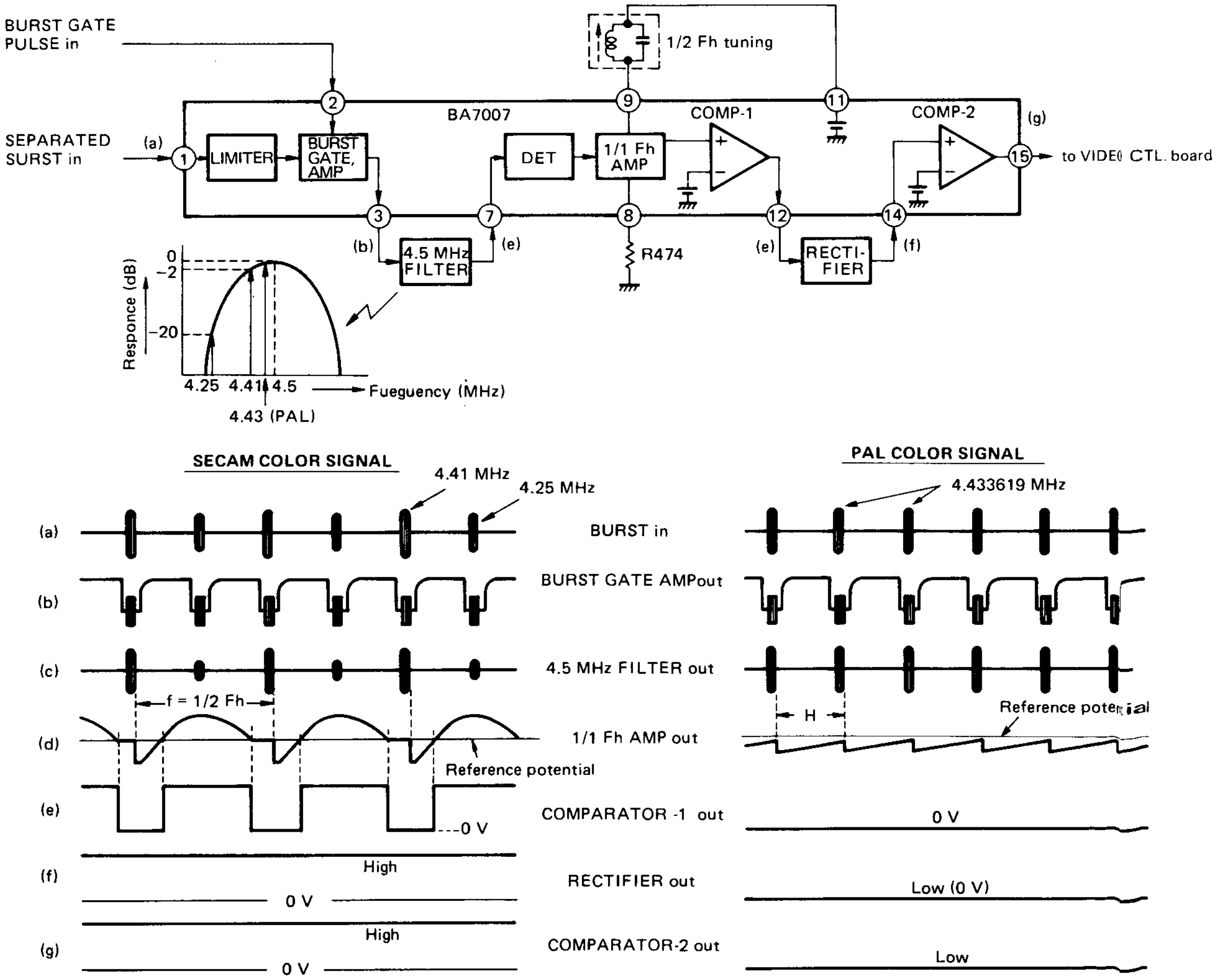

BURST GATE PULSE in
SEPARATED SURST in
(a)
1
LIMITER
BURST GATE, AMP
2
3
BA7007
DET
7
1/1 Fh AMP
9
8
1/2 Fh tuning
11
COMP-1
COMP-2
12
14
15
(g)
to VIDEO CTL. board
(b)
4.5 MHz FILTER
(e)
R474
(e)
RECTI-FIER
(f)
Responce (dB)
0
-2
-20
4.25
4.41
4.5
Fueguency (MHz)
4.43 (PAL)
SECAM COLOR SIGNAL
4.41 MHz
4.25 MHz
PAL COLOR SIGNAL
4.433619 MHz
(a)
BURST in
(b)
BURST GATE AMPout
(c)
4.5 MHz FILTER out
f = 1/2 Fh
H
Reference potential
(d)
1/1 Fh AMP out
Reference potential
(e)
COMPARATOR -1 out
0 V
0 V
(f)
High
0 V
RECTIFIER out
Low (0 V)
(g)
High
0 V
COMPARATOR-2 out
Low

Fig. 3-38 SECAM detector

Line correction in the tape pattern reduces crosstalk during playback and the 2 H delay line system for PAL is not employed. The SECAM detector circuit distinguishes between PAL and SECAM signals. With a SECAM signal, the phase shift and 2 H delay line circuit are cutoff.

Refer to the block diagram of Fig. 3-38.

During both recording and playback, the burst signal sampled by burst gate is sent from pin 1 to BA7007 limiter. The SECAM burst signal alternates every line between 282 Fh (4.40625 MHz) and 272 Fh (4.25 MHz) and after passing through the bell filter, the resulting burst level is not fixed. For this reason, the limiter shapes the waveform to produce a fixed level squarewave, which goes to the burst gate amplifier.

The burst gate pulse is supplied to BA7007 pin 1. This circuit removes components other than the burst which were amplified by the limiter. This output goes to the 4.5 MHz filter as waveform (b). The filter possesses the response indicated in the block diagram and passes the 282 Fh burst component, while attenuating the 272 Fh component. Waveform (c) illustrates the filter output.

Consequently, 4.5 MHz filter enhances the 282 Fh and attenuates the 272 Fh. The result is integrated by DET and the 1/2 Fh output is supplied to the 1/2 Fh amplifier.

The 1/2 Fh component is amplified and the Fh component attenuated by the L414, 1/2 Fh tuning circuit to produce waveform (d). This output is supplied to the comparator-1 non-invert input. The constant potential is supplied to the invert input as a reference signal for the comparator.
At this time, when the voltage at the non-invert input from the 1/2 Fh amplifier exceeds the reference voltage (about 6 V), the comparator-1 high output goes from pin 12 to the rectifier. When below the reference voltage, the comparator output becomes a low potential. Waveform (e) illustrates the comparator-1 output. This is fullwave rectified by CR to yield waveform (f). The rectifier high output is supplied to the comparator-2 to yield waveform (g).

When a PAL signal is received, the burst frequency becomes fixed at 4.433619 MHz every line. At this time, detector output is Fh, the 7.5 kHz amplifier output becomes a low potential.

In the case of SECAM recording, output is low, which goes via D403 to IC402 rotation control circuit. The 25 Hz drum flipflop signal becomes dropped to ground potential, defeating the phase shift circuit of the CH-2 head component.

During playback, the phase shift circuit is defeated by setting electronic Q609 off and Q608 on, preventing supply of the 2 H delay line output to the mixer. Only the bypass output from Ra goes to the mixer, thus avoiding adverse effects on the SECAM color FM signal due to mixing.

3.3.6 SECAM color signal system

Refer to the block diagram of Fig. 3-39.

1. Recording system

The color TV signal selected by the input select switch is applied to BPF501 for obtaining the color FM signal with central energy at the subcarrier (Fcr = 4.40625 MHz; Fcb = 4.25 MHz), which goes to IC501 AMP and DIF EQ AMP. Prior to BPF501, equalizer EQ501 delays the color component by about 400 nanoseconds (400 x 10^{-9} sec) to match the timing of the luminance signal on the recorded tape pattern.

DIF EQ AMP possesses characteristics similar to an bell filter and converts the anti-bell curve used during transmission to a flat energy distribution in preparation for 1/4 frequency countdown. The limiter circuit ensures correct countdown of the color FM signal from DIF EQ AMP.

From REC LIMITER, the limited signal goes to the 1/4 countdown circuit of IC501. This IC contains two D-flipflop stages by which the signal is counted down 1/2 at each stage to result in 1/4 countdown. The color FM carrier band is converted from 3.9 to 4.75 MHz to a range of 0.98 to 1.19 MHz, then supplied via IC501 pin 16 to BPF502.

For mixing with the highband FM luminance signal, BPF502 limits the upper range of the counted down color signal sideband, while the lower sideband range is limited in order to improve S/N and avoid color reversal during playback. The high sideband is limited to approximately 300 kHz and the lower sideband to about 600 kHz.
This output is amplified by IC501 pin 23 and pin 24 and sent to IC501 pin 25.

At the next stage, DIF EQ AMP possesses characteristics approximating those of an anti-bell filter with a center of 1.07 MHz (1/4 x 4.286 MHz). The unmodulated carrier component is attenuated and the design serves to improve S/N and avoid color reversal during recording and playback.

Electronic switch SW-4 serves to cut horizontal and vertical sync noise from the recording color signal. With the SECAM signal, the subcarrier is inserted in the H blanking period and the color identification signal in the V blanking interval. If noise is present it could interfere with detection of the subcarrier and identification signals at the TV receiver. Also, if the noise level is high, it could become mixed with the FM luminance signal and disrupt synchronization during playback. The noise component is therefore cut.

The noise arises in the H and V sync signals in the following manner. BPF501 attenuates the lowband luminance component of the input video signal, however, harmonics from the rapid rise and fall components of the sync signal cannot be completely removed. This leakage becomes amplified by the limiter and after countdown and delay, it appears as noise in the H and V sync components.

After cutting the noise, the color signal is sent to IC604 pin 8, then R545 (REC COLOR LEVEL) adjusts the color signal recording current.

As mentioned previously, a color killer circuit is not included in the color signal recording system. When the rear panel mode switch is set to COLOR, the circuit functions are not altered.
When set to B/W, low potential via conn. 155 goes through D502 to IC501. This cuts off color signal supply to REC AMP-1 and REC AMP-2.

2. Playback system

In the color playback system, bandpass filter BPF502 attenuates the luminance signal and passes the 1/4 counted down color signal.

Amplifier IC501 amplifies the counted down color signal from BPF502 and supplies it to the equalizer amplifier. The resonance circuit of L502 possesses nearly the opposite characteristics as the recording DIF EQ AMP.

At IC501 pin 12 and pin 18, limiter and doubler circuits convert the FM carrier frequency from the range of 0.98 to 1.19 MHz to the range of 1.95 to 2.38 MHz, which appears at pin 8. IC501 operates in the same manner as the demodulator circuit described in section 3.3.2 - 5.

The high sideband component, attenuated by BPF502 during recording in order to improve S/N and prevent color reversal, is reproduced by applying about 40 dB limiting.

The 1.95 to 2.38 MHz FM carrier and both sideband components from IC501 pin 8 go to BPF503, which attenuates the carrier fundamental component. At the same time, both sideband components are passed and supplied to the doubler circuit of IC501 pin 7.

This IC operates in the same manner as IC501 pin 8, pin 12 to again double the frequency.

After returning the FM carrier to the original range of 3.9 to 4.75 MHz, the color FM signal is supplied to HPF401. In the same manner as during recording, SW-5 prior to HPF501 cuts H and V sync noise which has become amplified by the limiter. By providing this circuit prior to HPF501, switching noise can be removed from the final output.

HPF501 removes the fundamental carrier leak component from the IC501 doubler output. DIF EQ AMP attenuates the luminance signal area for mixing with the demodulated lowband AM luminance signal and limits the color FM signal sidebands to about ±1 MHz, then supplies the signal to AMP-3.

DIF EQ AMP possesses characteristics very similar to an anti-bell filter. The unmodulated carrier component is attenuated and an anti-bell response imparted to yield the equivalent of the transmitted signal. R543 (PROCESSED COL. LEVEL) adjusts the output level. Mixing with the PB luminance signal is performed at IC106 to produce the video output signal. Remaining operations are the same as for the luminance signal playback system.

Although a playback color killer circuit is absent, setting the mode select switch to B/W supplies low potential via D502 to the IC501 pin 20. This turns on SW-5 and prevents PB color signal supply to subsequent circuits. Only the luminance signal is obtained at the output.

3-41

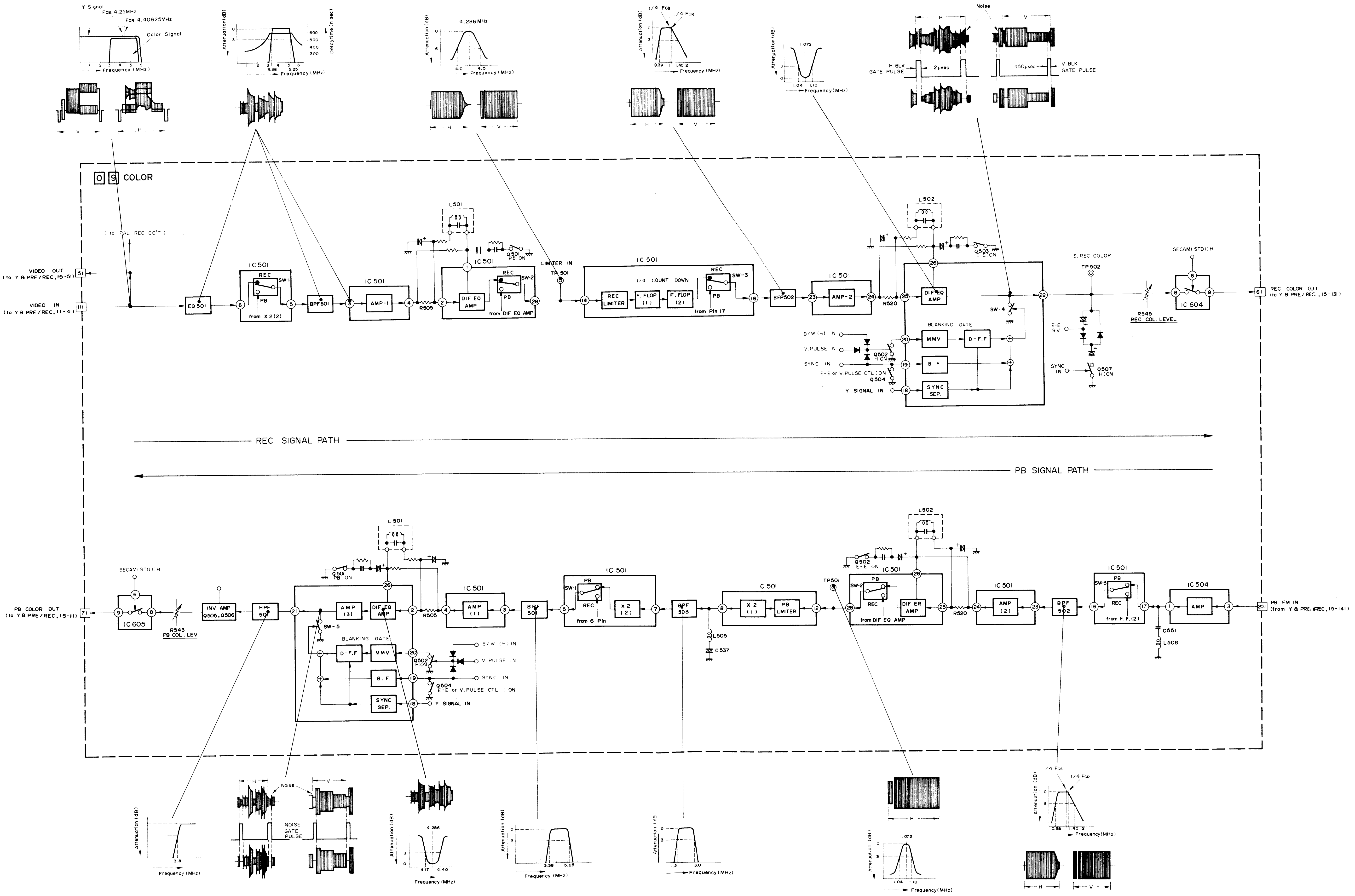

0 9 COLOR
(to PAL REC CC'T)
VIDEO OUT (to Y & PRE/REC, 15-51)
VIDEO IN (to Y & PRE/REC, 11-41)
51
111
EQ 501
IC 501
REC
SW-1
PB
from X 2(2)
BPF501
AMP-1
R505
L501
DIF EQ AMP
SW-2
from DIF EQ AMP
Q501 PB ON
LIMITER IN
TP 501
1/4 COUNT DOWN
REC LIMITER
F. FLOP (1)
F. FLOP (2)
SW-3
from Pin 17
BFP502
AMP-2
R520
L502
Q503 E-E ON
SW-4
BLANKING GATE
MMV
D-F.F
B. F.
SYNC SEP.
B/W (H) IN
V. PULSE IN
SYNC IN
Q502 H:ON
E-E or V.PULSE CTL : ON
Q504
Y SIGNAL IN
S. REC COLOR
TP 502
E-E 9V
Q507 H:ON
SECAM(STD) : H
R545
REC COL. LEVEL
IC 604
REC COLOR OUT (to Y & PRE/REC, 15-131)
61
REC SIGNAL PATH
PB SIGNAL PATH
PB COLOR OUT (to Y & PRE/REC, 15-111)
71
IC 605
R543
PB COL. LEV.
INV. AMP Q505, Q506
HPF 501
AMP (3)
DIF EQ AMP
SW-5
D-F.F
MMV
B. F.
SYNC SEP.
Q501 PB ON
AMP (1)
BPF 501
SW-1
PB
REC
X 2 (2)
from 6 Pin
BPF 503
L505
C537
X 2 (1)
PB LIMITER
TP501
SW-2
DIF ER AMP
from DIF EQ AMP
Q502 E-E ON
AMP (2)
BPF 502
SW-3
from F. F. (2)
C551
L506
IC 504
AMP
PB FM IN (from Y & PRE/REC, 15-141)
201
Y Signal
FCB 4.25MHz
FCR 4.40625MHz
Color Signal
Frequency (MHz)
Attenuation (dB)
Delaytime (n sec)
3.38
5.25
4.286MHz
4.0
4.5
1/4 FCB
1/4 FCR
0.39
1.40
1.072
1.04
1.10
Noise
H.BLK GATE PULSE
2μsec
450μsec
V.BLK GATE PULSE
H
V
3.8
NOISE GATE PULSE
4.286
4.17
4.40
1.2
3.0
0.38

Fig. 3-39 SECAM color signal block diagram

3.4 AUDIO SYSTEM

3.4.1 General

Although the magnetic tape pattern of the VHS format is sufficiently flexible to allow use with two track audio systems, this particular model is designed for monophonic audio recording and playback.

For audio signal inputs are provided:
1) TUNER audio input from the built-in tuner,
2) AUX audio input from the rear panel 5-pin DIN socket,
3) CAMERA audio input from the 10-pin camera connector, and
4) Microphone input via the MIC jack.

When a microphone is not connected, the REC SELECT switch selects AUX, TUNER and CAMERA input signals for recording.

With this model, the microphone input can be mixed with another input signal selected by the REC SELECT switch.

Audio outputs are also provided in four lines, as follows:
1) Through conn. 52 to the RF converter,
2) Via conn. 42 to the rear panel 5-pin DIN socket,
3) To the headphone jack through conn. 11, and
4) Via conn. 61 and conn. 63 to the CAMERA connector.

Conn. 63 is an input during recording and an output during playback.

3.4.2 Block diagram description

Refer to the block diagram of Fig. 3-40.

1. Recording system

The TV sound signal selected by the built-in tuner goes to conn. 31 and appears at –14 dBs level at SW-1. An auxiliary audio input from the rear panel 5-pin DIN socket is supplied via conn. 44 to SW-2 at –20 dBs level. A camera audio input at the CAMERA connector is sent through conn. 63 to SW-3 at –20 dBs level.

A microphone input signal goes via conn. 72 to IC2 pin 14. The mic amp increases the level by about 40 dBs. In absence of a microphone connection, Q1 switches on to cutoff the mic amp output to prevent influence on the signal to noise ratio.

The signals from SW-1, SW-2, SW-3 and the mic amplifier are mixed at R31, R32 and R33, and supplied to IC2 pin 12 (REC LINE AMP). Through SW-4 within the IC, the signal appears at TP31 (LINE AMP OUT). Frequency response of the recording line amplifier is indicated in the block diagram.

Amplifier A of IC3 amplifies the signal from SW-4 approximately 12 dBs and supplies it to the lowpass filter (LPF). As shown in the block diagram, this filter passes frequencies below 12 kHz and attenuates higher frequencies. Its purpose is mainly to prevent the 15.625 kHz video component from affecting the Dolby* NR circuit.

From the LPF, the signal is amplified approximately 18 dBs by amplifier B of IC3, then branched to the E-E and recording systems. (The E-E system is outlined in the Playback System description.)

> *Noise reduction system manufactured under license from Dolby Laboratories Licensing Corporation.
> Dolby and the double-D symbol are trademarks of Dolby Laboratories Licensing Corporation.

Amplifier B output is supplied to circuit EK of IC3 for encoding in the Dolby-B format. If the DOLBY NR switch is set to OFF, circuit EK functions simply as an amplifier and does not perform encoding.

The signal from EK goes to IC4 pin 5 (REC AMP). The approximately 12 kHz peak of the recording amplifier is determined by the constant of L2, R100 and C55.

Electronic switch Q12 is off in the recording mode. From the recording amplifier, the equalized audio signal is sent through the audio bias trap composed of L5 and C71, mixed with bias from C66, then applied via conn. 81 to the audio head.

During recording, electronic switch Q16 is on and the bias oscillator of Q17, Q18 and T1 operates. This output becomes the audio bias through C66 that is mixed with the audio signal.

Electronic switches Q6 to Q9 are cutoff in the recording mode.

2. Playback system

The playback signal from the audio head goes at approximately –68 dBs level via conn. 83 to IC2 pin 2 (PRE AMP). Electronic switches Q6 to Q9 are on during playback and conn. 81 is grounded. Q10 is off in the playback mode, but on during recording (at which time conn. 83 is grounded).

The block diagram shows the frequency response of the preamplifier and this is determined by the playback equalizer composed of C28, R65 and R66. Through the playback line amplifier and SW-4, the signal is amplified about 14 dBs and sent to IC3 pin 4 (amplifier A).

In the same manner as for recording, the signal goes through the LPF, amplifier A and circuit EK to IC3 pin 9. Via SW-5, the output appears at IC3 pin 8 (TP4). The frequency response at TP14 is shown in the block diagram. During the muting function (slow and still modes), electronic switch Q11 switches on to cutoff the audio signal.

The TP14 (MONITOR OUT) signal is supplied to IC4 pin 3 (OUTPUT AMP), where it is amplified approximately 7 dBs and obtained at IC4 pin 1.

From this point, the signal is sent to the following four outputs.

1) From conn. 52 at 0 dBs to the RF converter,
2) From conn. 42 at −6 dBs to the 5-pin DIN socket,
3) From conn. 11 at −32 dBs (8 Ω load) to the headphone jack, and
4) From conns. 61 and 63 at −6 dBs to the camera connector.

E-E line

Without going through circuit EK, the signal from IC3 pin 6 (amplifier B) proceeds via SW-5 to IC3 pin 8 (TP14). This is amplified and sent from IC4 pin 3 (OUTPUT AMP) to the four output lines.

In addition, one output of IC4 is supplied to the AGC amplifier composed of D1, D2, Q3 and Q4. This circuit automatically controls the gain only in the recording and E-E modes. As can be noted from the input/output response indicated in the block diagram, attenuation is linear with an input below −20 dBs. Above −20 dBs, the AGC circuit functions to maintain an approximately 2 dBs output.

Electronic switch Q2 is on during playback, discharging C22 and grounding D1 and D2 (DET) output. This prevents leakage from the input signal lines during playback.

3. Cue signal and audio dubbing systems

1) Cue signal

The cue signal is a 30 Hz squarewave supplied to the full erase head for about one second when the recording mode is initially entered, at which time it becomes recorded on the tape. However, the cue signal is not recorded at the transition between the pause and recording modes.

During playback the cue head (mounted on the tension pole) picks up the cue signal and if the SEARCH switch is set to CUE, this signal functions as the auto stop signal.

Low potential from the mechacon circuit is applied via conn. 91 to D7 cathode and Q13 base. Q13 switches on to supply 22 V DC to IC5 pin 3. Consequently, the cue signal becomes obtained from IC5 pin 6. It is amplified by Q14 and Q15, and supplied to pin 9 of relay RY-1. D7 switches on, switching the relay on and shorting pins 9 and 13. The cue signal then goes via conn. 104 to the full erase head.

Approximately one second later, conn. 91 returns to high potential, which cuts off Q13 and stops the cue oscillator. At the same time, D7 cuts off and the relay becomes cutoff.

2) Audio dubbing system

Low potential appears at conn. 96 during the audio dubbing mode. Diode D8 and the relay switch on, thus inhibiting the full erase head. However, since the full erase head also functions as load for the bias oscillator, in order to prevent recording current variation, L4 becomes connected as a dummy load.

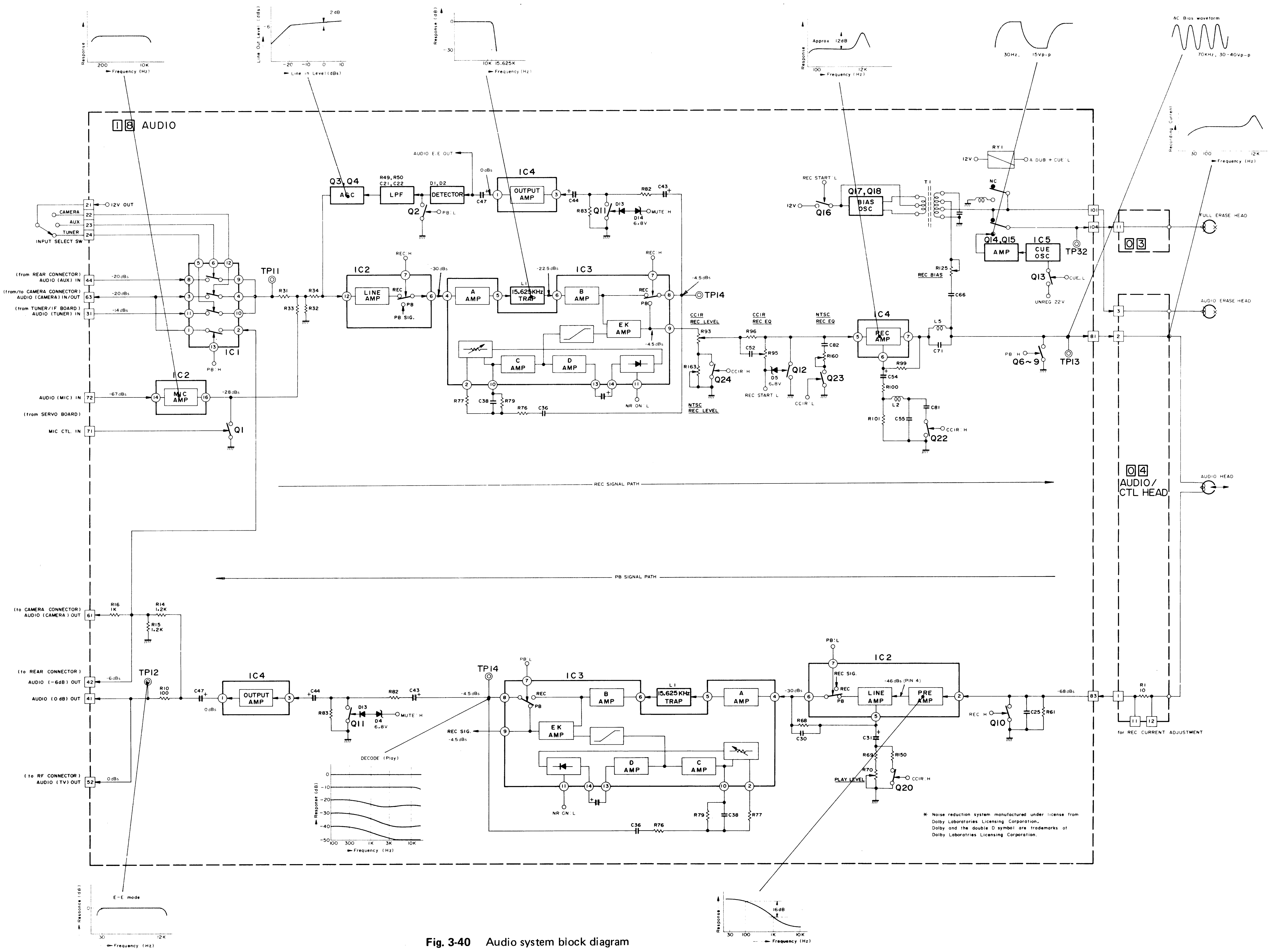

18 AUDIO
Response
200
10K
Frequency (Hz)
Line Out Level (dBs)
2dB
-6
-20
-10
0
10
Line In Level (dBs)
Response (dB)
0
-30
10K 15.625K
Frequency (Hz)
Approx 12dB
100
12K
AC Bias waveform
30Hz, 15Vp-p
70KHz, 30-40Vp-p
Recording Current
30 100 12K
12V OUT
CAMERA
AUX
TUNER
INPUT SELECT SW
(from REAR CONNECTOR) AUDIO (AUX) IN
(from/to CAMERA CONNECTOR) AUDIO (CAMERA) IN/OUT
(from TUNER/IF BOARD) AUDIO (TUNER) IN
AUDIO (MIC) IN
(from SERVO BOARD)
MIC CTL IN
-20dBs
-14dBs
-67dBs
-28dBs
IC1
IC2
MIC AMP
Q1
TP11
R31
R34
R33
R32
Q3, Q4
AGC
R49, R50 C21, C22
LPF
D1, D2
DETECTOR
Q2
PB·L
AUDIO E-E OUT
0dBs
C47
IC4
OUTPUT AMP
C44
R82
C43
R83
Q11
D13
D14 6.8V
MUTE·H
IC2
LINE AMP
REC·H
REC
PB
PB SIG.
-30dBs
-22.5dBs
A AMP
L1 15.625KHz TRAP
IC3
B AMP
EK AMP
C AMP
D AMP
-4.5dBs
TP14
R77
C38
R79
R76
C36
NR ON·L
NTSC REC LEVEL
CCIR REC LEVEL
R93
R163
Q24
CCIR·H
CCIR REC EQ
R96
C52
R95
D5 6.8V
REC START·L
Q12
NTSC REC EQ
C82
R160
Q23
CCIR·L
REC START·L
12V
Q16
Q17, Q18
BIAS OSC
T1
RY1
A DUB + CUE·L
NC
Q14, Q15
AMP
IC5
CUE OSC
TP32
Q13
CUE·L
UNREG 22V
R125
REC BIAS
C66
IC4
REC AMP
L5
C71
C54
R99
R100
L2
C81
R101
C55
CCIR·H
Q22
PB·H
Q6~9
TP13
101
104
81
03
FULL ERASE HEAD
AUDIO ERASE HEAD
04
AUDIO/CTL HEAD
AUDIO HEAD
REC SIGNAL PATH
PB SIGNAL PATH
(to CAMERA CONNECTOR) AUDIO (CAMERA) OUT
R16 1K
R14 1.2K
R15 1.2K
(to REAR CONNECTOR) AUDIO (-6dB) OUT
AUDIO (0 dB) OUT
(to RF CONNECTOR) AUDIO (TV) OUT
-6dBs
0dBs
TP12
R10 100
C47
IC4
OUTPUT AMP
C44
R82
C43
R83
Q11
D13
D4 6.8V
MUTE·H
TP14
PB·L
IC3
REC SIG.
-4.5dBs
B AMP
L1 15.625KHz TRAP
A AMP
EK AMP
D AMP
C AMP
NR ON·L
R79
C38
R77
C36
R76
-30dBs
R68
C30
PB·L
IC2
REC SIG.
REC
PB
-46dBs (PIN 4)
LINE AMP
PRE AMP
C31
R69
R150
R70
PLAY LEVEL
CCIR·H
Q20
-68dBs
REC·H
Q10
C25
R61
83
R1 10
for REC CURRENT ADJUSTMENT
DECODE (Play)
Response (dB)
0
-10
-20
-30
-40
-50
100
300
1K
3K
10K
Frequency (Hz)
E-E mode
Response (dB)
0
30
12K
Frequency (Hz)
Response
16dB
30
100
1K
10K
Frequency (Hz)
✱ Noise reduction system manufactured under license from Dolby Laboratories Licensing Corporation. Dolby and the double D symbol are trademarks of Dolby Laboratries Licensing Corporation.

Fig. 3-40 Audio system block diagram

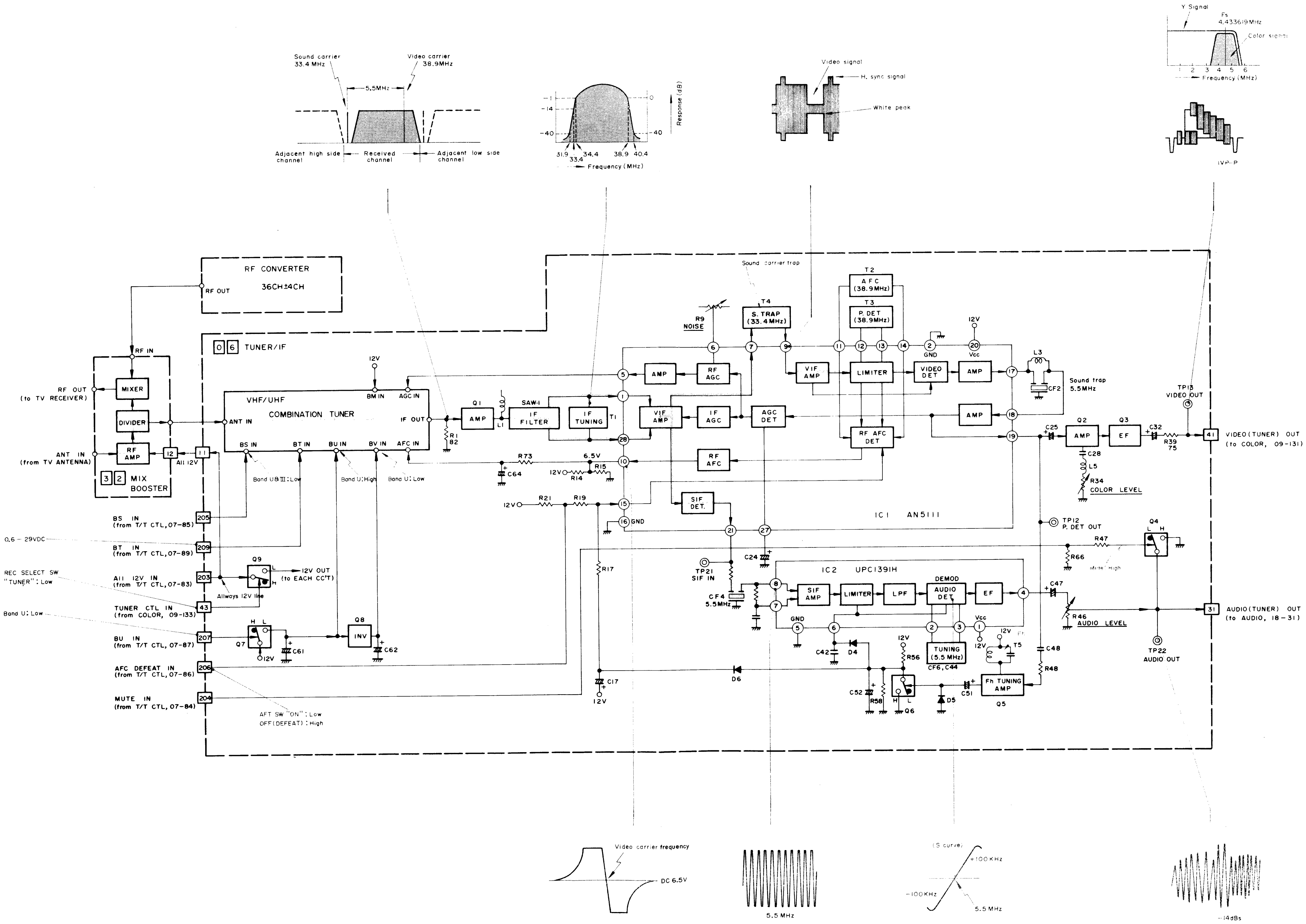

Sound carrier 33.4 MHz
Video carrier 38.9MHz
5.5MHz
Adjacent high side channel
Received channel
Adjacent low side channel
-1
-14
-40
0
-40
Response (dB)
31.9
33.4
34.4
38.9
40.4
Frequency (MHz)
Video signal
H. sync signal
White peak
Y Signal
Fs 4.433619MHz
Color signal
1 2 3 4 5 6
Frequency (MHz)
1VP-P
RF CONVERTER
RF OUT
36CH±4CH
RF IN
MIXER
DIVIDER
RF AMP
RF OUT (to TV RECEIVER)
ANT IN (from TV ANTENNA)
3 2 MIX BOOSTER
12
11
All 12V
0 6 TUNER/IF
12V
VHF/UHF COMBINATION TUNER
BM IN
AGC IN
ANT IN
IF OUT
BS IN
BT IN
BU IN
BV IN
AFC IN
Band U&III : Low
Band U : High
Band U : Low
R1 82
BS IN (from T/T CTL, 07-85)
0.6 – 29VDC
BT IN (from T/T CTL, 07-89)
REC SELECT SW "TUNER" : Low
All 12V IN (from T/T CTL, 07-83)
Q9
12V OUT (to EACH CC'T)
Allways 12V line
TUNER CTL IN (from COLOR, 09-133)
Band U : Low
BU IN (from T/T CTL, 07-87)
Q7
H L
12V
C61
Q8
INV
C62
AFC DEFEAT IN (from T/T CTL, 07-86)
MUTE IN (from T/T CTL, 07-84)
AFT SW "ON" : Low
OFF (DEFEAT) : High
205
209
203
43
207
206
204
Q1
AMP
L1
SAW-1
IF FILTER
IF TUNING
T1
R73
C64
6.5V
12V
R14
R15
R21
R19
R17
C17
R9 NOISE
Sound carrier trap
T4
S. TRAP (33.4MHz)
T2
AFC (38.9MHz)
T3
P. DET (38.9MHz)
AMP
RF AGC
VIF AMP
IF AGC
AGC DET
RF AFC
SIF DET.
VIF AMP
LIMITER
VIDEO DET
RF AFC DET
GND
Vcc
12V
AMP
AMP
L3
CF2
Sound trap 5.5MHz
IC1 AN5111
16 GND
TP21 SIF IN
CF4 5.5MHz
C24
IC2 UPC1391H
SIF AMP
LIMITER
LPF
DEMOD
AUDIO DET
EF
TUNING (5.5 MHz)
CF6, C44
C42
D4
D6
R56
C52
R58
Q6
D5
C51
Fh TUNING AMP
Q5
T5
C48
R48
C25
Q2
AMP
Q3
EF
C32
R39 75
C28
L5
R34 COLOR LEVEL
TP13 VIDEO OUT
41
VIDEO (TUNER) OUT (to COLOR, 09-131)
TP12 P. DET OUT
R47
R66
Mute: High
Q4
L H
C47
R46 AUDIO LEVEL
31
AUDIO (TUNER) OUT (to AUDIO, 18-31)
TP22 AUDIO OUT
Video carrier frequency
DC 6.5V
5.5 MHz
(S curve)
+100KHz
-100KHz
5.5 MHz
-14dBs

Fig. 3-41 Tuner/IF block diagram

3.5 TUNER/IF CIRCUIT

3.5.1 General

This model incorporates a combination VHF/UHF tuner. The band select switch (Tuner/Timer Control board) selects from among three positions of I (VHF channels 2 to 4), III (VHF channels 5 to 12) and U (UHF channels 21 to 69).

Preset tuning is performed by using a single tuning control and a voltage synthesizer system. These functions are controlled by voltages from the T/T CTL circuit.

Refer to the tuner/IF block diagram of Fig. 3-40.

3.5.2 Circuit description

1. Video detector circuit

Broadcast television signals are supplied to the antenna input (ANT IN) of the mix booster, from which the RF amplifier amplifies only the portion subject to loss at the next stage divider. One output of the divider is mixed with the CH-36 RF signal from the RF converter and supplied via the RF OUT terminals to the connected TV receiver.

Another output of the divider goes to the ANT IN connection of the tuner.

When the REC SELECT switch is set to TUNER in the recording or E-E mode, low potential at conn. 43 (TUNER CTL IN) switches Q9 on to supply 12 V to the circuits. In the playback mode, high at conn. 43 inhibits tuner/IF operation.

So long as the rear panel main power switch is on and the unit is connected to a live AC power source, 12 VDC at conn. 203 (ALL 12 V IN) is supplied to both Q9 and the mix booster. When the CH PRESET switch is on, the T/T CTL circuit supplies approximately 0.7 V DC for bands III and U, and 30 V DC for band I to conn. 205 (BS IN).

The T/T CTL circuit also sends low potential to conn. 207 (BU IN) for band U and high potential for bands I and III. Since Q8 is an inverter, when band U is off, low potential becomes sent to BV IN.

As noted above, conns. 205 and 207 are band select input terminals. The band select output voltages become as indicated in Table 3-5.

BAND	BS IN	BU IN	BV IN
U	less than 0.8 V	more than 11.5 V	less than 0.8 V
III	less than 0.8 V	less than 0.8 V	more than 11.5 V
I	more than 30 V	less than 0.8 V	more than 11.5 V

Table 3-5 Band select output voltages

Regardless of the band, when the tuning control is turned fully counter-clockwise, 0.6 V DC is supplied to conn. 209 (BT IN). At the fully clockwise position, this becomes 29 V DC. In other words, the tuning control varies the tuning voltage in the range from 0.6 to 29 V DC.

As a result, the selected channel TV signal is converted to an intermediate frequency which appears at TUNER IF OUT at 75 Ω impedance.

The video carrier frequency of the IF signal from the tuner is 38.9 MHz.
At the same time, the difference between video and sound carrier frequencies is 5.5 MHz.

R1 adjusts the impedance of the IF signal from the tuner, which is then amplified and applied to the IF filter.

SAW-1 of the IF filter is a surface acoustic wave resonator, which features a single resonance point without the need for a tuning circuit and low spurious signal production. Since SAW-1 output tends to attenuate the adjacent bands, L1 and T1 compensate for the low and high bands to yield the response indicated in the block diagram.

The output goes to pins 1 and 28 of IC1 VIF amplifier. The 3 stage differential amplifier output of the video IF amp goes from pin 7 to again enter the IC at pin 9. Sound trap T4 between pins 7 and 9 is a sound carrier trap. Via pin 9, the video IF signal is sent to the video detector stage.

A differential amplifier is used by the sync detector type video detector. The VIF amplifier increases the signal to an adequate level for driving the detector, then supplies two outputs at opposite phase to the video detector. Through the limiter, the signal is fullwave rectified in a double balanced connection to become the detector output.

Transformer T3 connected to the limiter resonates at the video carrier frequency and applies a precise same phase input waveform to the video detector. The video detector output is amplified and obtained as a positive polarity video signal from pin 17.

Through audio trap CF2 (5.5 MHz), the signal is amplified and inverted at pin 18 and obtained from pin 19. Q2 inverts and amplifies the signal and an emitter-follower converts its impedance. C32 cuts the DC component and the resulting positive (TUNER) video signal goes via conn. 41 to the color board.

R34 (COLOR LEVEL) adjusts the color level at the L5 & C28 subcarrier frequency resonance circuit of Q2 amplifier.

2. RF AFC circuit

The RF AFC (automatic frequency control) detector functions in the same manner as the video detector. The two limiter signals at 90° phase relationship are applied to this circuit to produce the output. T2 of the RF AFC detector and T3 of the picture detector are connected to adjacent pins of IC1, producing a capacitance coupling effect equivalent to 1 to 2 pF.

At the time of video carrier frequency resonation, 90° phase difference is produced in the inputs from the limiter and the RF detector output becomes zero. The phase difference fluctuates according to the deviation from the resonance frequency. As indicated in the block diagram, by detecting the phase, the RF AFC output is obtained with positive and negative variation centered on the video carrier frequency. This output goes via pin 10 to the tuner AFC input and controls the local oscillator frequency.

When the AFT (automatic fine tuning) switch of the T/T CTL board is on, low potential goes to the RF AFC detector, which then operates as described above.
If the AFT switch is OFF, 12 V via R21 through pin 15 cuts off the RF AFC output.
At this time, the high impedance of R14 and R15 supplies fixed 6.5 V to the tuner AFC.

3. AGC circuit

The reverse polarity video level forms the AGC (automatic gain control) detector input at IC1 pin 19. One detector output goes through the IF AGC circuit and controls the equivalent emitter resistance at the first stage of the VIF two stage differential amplifier.

The other AGC detector output is sent to the RF AGC and amplifier circuits, then via pin 5 to the tuner AGC input, where it controls the gain of the tuner output. R9 (NOISE) at pin 6 adjusts for minimum noise in the output with respect to the level at the antenna input.

4. Audio detector circuit

An intercarrier system is used by which the video and sound carriers produce an FM beat signal that becomes the second audio IF signal. The output of the video IF amplifier goes to the sound IF detector. Detection is performed by using the diode function between the base and emitter of the SIF amplifier transistor.

The 5.5 MHz component is obtained at pin 21. Ceramic filter CF4 selects only that frequency component, which then goes to pins 7 and 8 of IC2. The signal is amplified by the SIF amplifier and sent through the limiter and lowpass filter circuits to the FM audio detector.

CF6 and C44 form a tuning circuit between pins 2 and 3 for producing the "S" curve requird for driving the differential amplifier type FM detector. Consequently, amplitude variations in accordance with frequency deviation appear at opposite polarity at pins 2 and 3, forming an "s" curve as indicated in the block diagram. This is fullwave rectified and obtained through an emitter-follower.

C47 cuts the DC component of the IC2 pin 4 output and R46 (AUDIO LEVEL) adjusts the level, after which the signal goes via conn. 31 to the audio board as the audio (TUNER) signal.

When mute high potential from the T/T CTL board appears at conn. 204, Q4 switches on, grounding the audio output. This operation is performed during channel select.

5. Audio muting

This circuit detects the horizontal sync signal and functions to prevent audio noise when the video output is not precisely tuned.

R48 and C48 form a highpass filter which attenuates the video component of the reverse polarity signal from IC1 pin 19. The Fh (15.625 kHz) tuning amplifier of Q5 and T5 yields the horizontal sync signal. C51 cuts the DC component and D5 clamps the positive sync tip to zero potential. Q6 switches on and off with the horizontal sync signal.

Electronic switch Q6 is off only at the sync tip and on at other times due to high potential. Consequently, the charging time of C52 from 12 V through R56 is much shorter than the discharge time through R58. D4 becomes cutoff and IC2 normally operates.

However, when tuning deviates, the horizontal sync signal is not obtained. This completely cuts off Q6 and C52 charges to saturation. The resulting high output goes via D4 to IC2 pin 6, cutting off the limiter and audio detector circuits of IC2 and preventing the audio output.

3.6 TUNER/TIMER CONTROL AND DISPLAY CIRCUIT

3.6.1 Introduction

This machine uses a voltage synthesizer tuning system with a single preset VR. In this system, the tuning voltage is converted into a digital value and stored in a ROM. The data corresponding to the selected channel is converted into an analog signal which is in turn sent to the tuner/IF board.

The timer permits setting of 8 programs up to 2 weeks in advance. The recording length can be set up to 395 minutes in 5-minute increments. Moreover, the timer permits setting of recording date, channel and start time.

This sytem consists of IC206 MB8851AM-143L (timer control), IC207 UPD552C-088 (tuner control) and IC401 UPD552C-079 (display driver).

3.6.2 Circuit description - 1

1. Tuning circuit

Both the HR-7700 and HR-7600 employ a voltage synthesizer system for the tuning section. However, in contrast to the completely automatic system of the HR-7700, the HR-7600 system uses a preset control. Some users find this latter method easier to employ, while the simplified circuit provides an advantage from a servicing point of view.

Refer to the block and schematic diagrams. The HR-7600 uses the μPD552C for tuner control, which possesses a lower memory capacity than the μPD553C employed for the HR-7700. Also, in the HR-7600 system, tuning system performance depands to a large degree on the preset control voltage detection error during preset.

At the DC comparator, the voltage set by the PRESET control and the DC voltage from a digital to analog converter (DAC) are compared. The accuracy of this detection is an important factor in determing tuner performance. A microcomputer program was developed for the HR-7600 to maintain the voltage detection error during tuning at less than 4 mV. Refer to the microcomputer flowchart.

The PRESET switch is set to ON when performing channel preset. At this time, the microcomputer instructs the DAC (IC202) to produce a pulse width corresponding to 15 VDC. This is equivalent to 1/2 the output of the DAC internal 12 bit counter. This counter increments in steps from 1 to 4096 to vary the tuning DC voltage in 7 mV steps from 0 to 30 V. By first setting the counter to 2048, the DAC output becomes 15 VDC. Consequently, the DAC counter becomes set to:

1000 0000 0000

A lowpass filter (LPF) delays the output 50 msec and the DC comparator output is polled.

At this time, if the DAC output is higher than the preset DC value, the CPU instructs the DAC to reduce the voltage. Conversely, if the voltage is lower, a higher output is instructed.

From the IC207 pin 3 output at part C3, the CPU detects whether the DAC voltage is higher or lower than the preset voltage. At this time, the relationship among the CPU input, DAC out put and PRESET control becomes as follows.

*If the 15 V DC DAC output is higher than the preset value:

→ Low potential appears at IC207 pin 3	→	CPU issues 1.85 V "DOWN" command to DAC ↓
1000 0000 0000 When 15 V DC ↓ 1.85 V DC down ↓		Upper 4 bits of DAC counter decrement by 1.85 V ↓
0111 0000 0000 15 V – 1.85 V		After 16 msec delay, DC comparator is again sampled.

*If the 15 V DC DAC output is lower than the preset value:

→ High potential appears at IC207 pin 3	→	CPU issues 1.85 V "UP" command to DAC ↓
1000 0000 0000 When 15 V DC ↓ 1.85 V DC up ↓		Upper 4 bits of DAC counter increment by 1.85 V ↓
1001 0000 0000 15 + 1.85 V		After 16 msec delay, DC comparator is again sampled.

The CPU controls the upper 4 bits of the DAC internal 12 bit counter. The tuning voltage becomes divided into 16 steps of 1.85 V each for varying the DAC output. This allows the DAC output to quickly follow any position of the PRESET control.

In practice, although the DAC counter is incremented one step at a time if its output is less than the PRESET control value, if a greater value is detected, the CPU issues a 2 step "POWN" instruction. This is to compensate for the delaying action of the lowpass filter circuit between CPU ports C and E. Thus, the down instruction becomes: 1.85 x 2 steps = 3.75V.

The CPU next sets the internal counter to 8 and polls the band data input. These data are detected from the lower two bits of the 16 bit channel data, as indicated in Fig. 3-42.

CPU ports C0, C2 and C3 detect the BAND switch state and accordingly issue the two bit data. After band selection, the CHANNEL SET LED lights and the skip settings are detected. In the case of a skipped channel, low potential appears at CPU ports C0, C2 and C3. In absence of skip, DAC less than VR status is checked.

Fine adjustment is then performed in 15 mV per step. This selects the lower 2 bits of the 12 bit counter. The DAC output continues to increase at 15 mV per step and at the point the value exceeds the VR setting, the internal counter decrements one count. This operaiton repeats 8 times until the internal counter reaches 0. After 8 repetitions of this process, the DC output of the DAC is brought to within the range of ±4 mV of the PRESET control value.

In this state, the CPU waits for pressing of the STORE button, at which time, the DAC voltage is checked for a value in the range of ±120 mV of the VR setting potential. The program counter is set to 8 and DAC less than VR status is checked. If less, the DAC +2 mV instruction is issued.

However, the 12 bit DAC counter possesses a maximum resolution of 4096 steps at 7.3 mV per step. Threfore, when the STORE button is pressed and the fine tuning process entered, the CPU employs the two bits at positions 13 and 14 of the 16 bit per channel data and applies these to the internal 6 bit counter. This 6 bit counter controls 1/4th division and the 7.3 mV becomes divides by 4 to yield approximately 2 mV per step as the DAC-2 output. Following the 1 step variation, the LED lights, DAC greater than VR status is checked, and counter decrement is performed.

After repeating this operation 8 times, via the lowpass filter, two steps (–4 mV) down count is performed. These data are then written into memory IC205.

CPU input				BAND DATA			
Co	C2	C3		BU	BS		BAND
L	L	H		OFF	H		V-Low
L	H	H		OFF	H		V-High
L	H	L		L	L		UHF
L	L	L		L	L		Skip

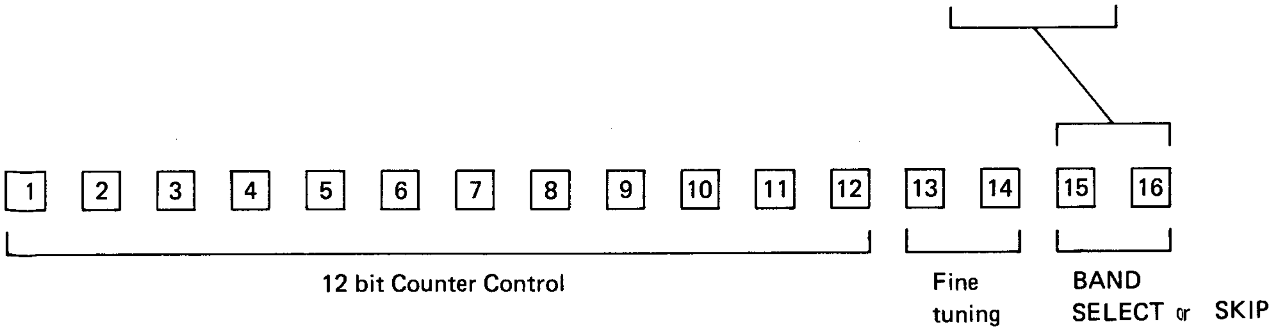


Fig. 3-42 16 bit CH data

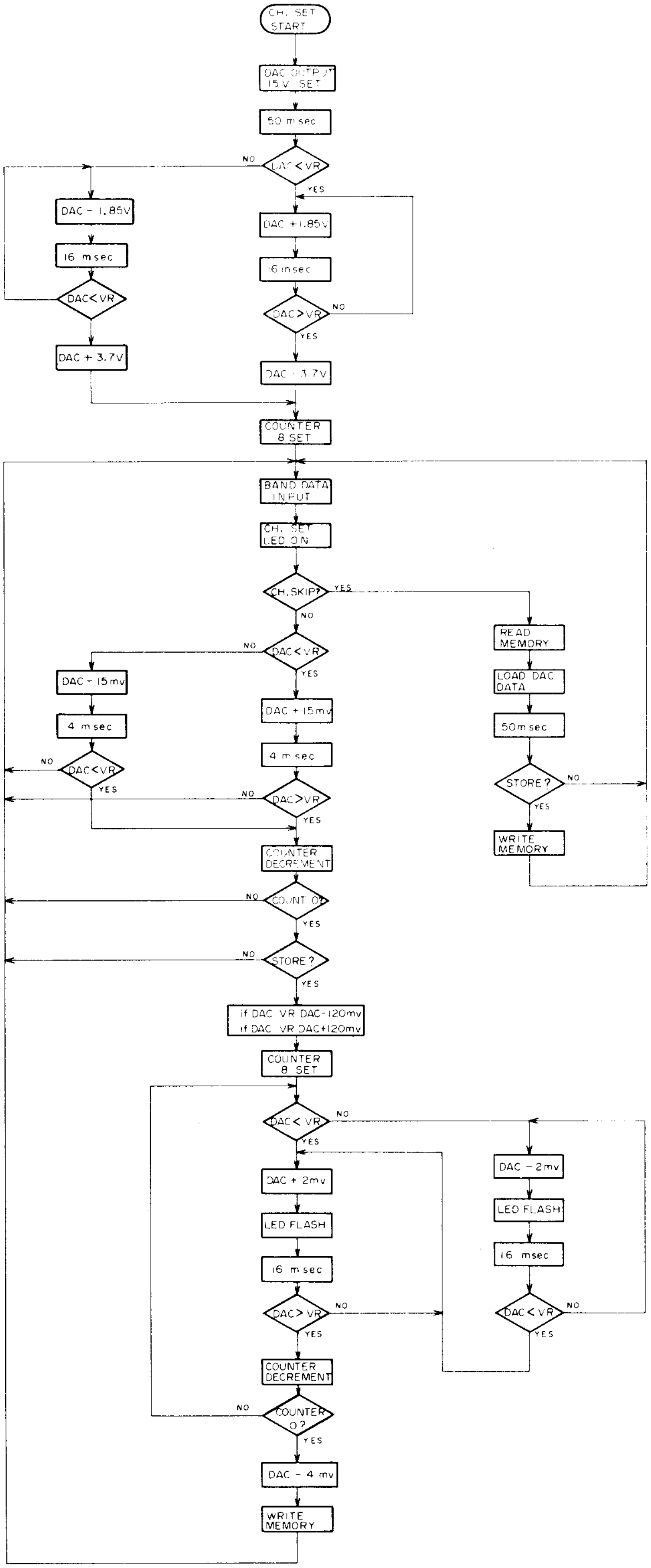

CH. SET START
DAC OUTPUT 15V SET
50 m sec
DAC<VR
NO
YES
DAC − 1.85V
16 msec
DAC<VR
DAC + 3.7V
DAC + 1.85V
16 msec
DAC>VR
NO
YES
DAC − 3.7V
COUNTER 8 SET
BAND DATA INPUT
CH. SET LED ON
CH. SKIP?
YES
NO
READ MEMORY
LOAD DAC DATA
50m sec
STORE ?
NO
YES
WRITE MEMORY
DAC<VR
NO
YES
DAC − 15mv
4 msec
DAC<VR
NO
YES
DAC + 15mv
4 m sec
DAC>VR
NO
YES
COUNTER DECREMENT
COUNT 0?
NO
YES
STORE ?
NO
YES
if DAC VR DAC-120mv
if DAC VR DAC+120mv
COUNTER 8 SET
DAC< VR
NO
YES
DAC + 2mv
LED FLASH
16 m sec
DAC> VR
NO
YES
DAC − 2mv
LED FLASH
16 msec
DAC< VR
NO
YES
COUNTER DECREMENT
COUNTER 0?
NO
YES
DAC − 4 mv
WRITE MEMORY

Fig. 3-43 Tuning system flow chart

2. Tuning operation outline

The microcomputer tuning system of this model is controlled by IC207 (μPD552C-088) of the T/T board. Refer to the block diagram. Basically, the tuner CPU controls the following functions.

1) Operation during tuning with PRESET control
2) Tuning operation using channel data written into memory IC
3) Write tuning data into memory
4) Channel skip

1) Tuning operation with PRESET control

With the channel PRESET switch set to ON, tuning becomes performed by the DC voltage value adjusted by the channel PRESET control. This VR adjusts the tuning voltage (BT) supplied to the tuner. Simultaneously, the DC voltage from the PRESET VR goes to the + side of the DC comparator, where it is compared with the input of the – side. The comparator output is supplied to CPU port C1.

This output is high level if the PRESET VR value is greater than the DAC output, and low level if it is less. Therefore, the CPU checks the PRESET VR DC voltage by polling the input level at port C1.

For example, if the PRESET VR value is greater than than the DAC value, high appears at CPU port C1 and the 4 bit data of port E control the IC202 (MN204E) DAC. The DAC contains an internal 12 bit counter and these data control the up/down counting direction.

Count is performed in steps from 1 to 4096. These DAC output steps are pulse width modulated and supplied to the lowpass filter. According to the pulse width, the LPF supplies a DC voltage to the – input of the DC comparator. The 12 bit counter control continues until the DC voltages of the PRESET VR and DAC output become essentially equal. Consequently, variation continues until the DAC voltage reaches the range of approximately ±0.4 mV of the PRESET VR voltage.

To summarize, when performing tuning adjustement, the PRESET switch is set to ON, then while observing the TV display, the PRESET VR is adjusted to the optimum setting. From this point, the CPU automatically instructs the DAC to produce an equal voltage to the PRESET VR setting potential, which becomes supplied as the LPF output.

In this state, when the STORE button is pressed, the DAC control data are automatically entered into the memory IC as the 16 bits per channel data.

2) Channel data memory

After tuning by use of the PRESET VR, pressing the STORE button writes the channel data into the memory IC. The memory storage capacity is 16 bits per channel times 16 channels, or 256 bits. About 2 to 3 seconds after the STORE button has been pressed, the CPU adjusts the tuning voltage to within approximately ±2 mV of the PRESET VR potential. During this time, the preset LED flashes on and off to indicate tuning operation.

When fine tuning is completed, the tuning data become written into the memory IC. Channel data write in commands from the CPU are in the form of 4 bit syllables. Thus, by sending 4 bit parallel data from the CPU 4 times, 16 bit data become written into the memory IC.

3) Write in timing

The timing diagram indicates the tuning data write in operation. At point (1) of the diagram, the memory lower group (G0) is set to input mode. Data input is performed at the pulse fall component of terminal CE. At the start of the CE fall component, the command (0, 0, 0, 0) is issued for setting the lower group to input mode, then the channel address data are entered. These data specify the channel from among the 12 memory channels. Addressing is performed using 4 bit BCD code.

Channel address data are entered at the start of the CE rise component (2). After setting the channel address (1 to 12), the data corresponding the particular channel are entered into the 16 bit memory. At the CE fall component, data write in command is sent to the G0 (group 0) area of the memory. Afterwards, at the rise component of CE, these are written into Data-1 (G0). In sequence, Data-2 (G1) input mode is set, and Data-3 (G2) and Data-4 (G3) are written. Maximum time required for write in is about 200 msec. Refer to the drawing for 16 bit data write in and data content.

4) Tuning data readout

Preset stations become tuned automatically when the CHANNEL button is pressed. Tuning is performed by using the 16 bit data sored in the memory and the specified channel is selected. These data are non-volatile and do not become erased when the power is cut off.

When the CHANNEL button is pressed, the CPU transfers the memory data at the following timing.

The CPU sets the command input mode for the lower address (G0) of the 16 bit memory. This is performed at the initial fall of CE by entering 0000 data drom the CPU into the memory.

Channel address data are entered at the CE rise component. The CPU detects which CHANNEL button has been pressed and converts this information into 4 bit BCD code, which goes to the memory as the channel address data.

At the next CE fall, the memory data output mode becomes set. Consequently, data in 4 bit syllables are obtained from memory IC output terminals Data-1, Data-2, Data-3 and Data-4, comprising a total of 16 bits, which are supplied to CPU D ports. Via the CPU, these data are transferred to the DAC to yield a pulse width proportional to the precise tuning voltage. The DC tuning voltage is then supplied through the LPF to the tuner.

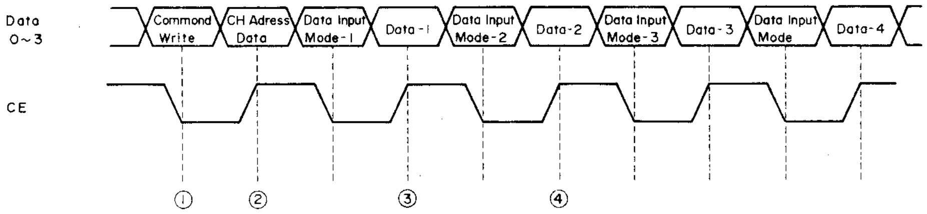

Data
0~3
Commond Write
CH Adress Data
Data Input Mode-1
Data-1
Data Input Mode-2
Data-2
Data Input Mode-3
Data-3
Data Input Mode
Data-4
CE
①
②
③
④

Fig. 3-44 Write in timing chart

3. IC Descriptions

1) MN1218A 256 bit MNOS non-volatile memory

This is an updated version of the MN1208A used for the HR-7700. The MN1218A is employed as the memory IC for the T/T circuit.

The MN1218A is a 256 bit non-volatile semiconductor memory which can be electrically reprogrammed. Memory capacity is 16 bits per TV channel, while internal data processing is possible in 4 bit groups (groups G0 to G3). Command inputs and data in/out processing are in 4 bit parallel format, allowing easy control by a microcomputer. The following table indicates data control of the MN1218A.

Control Operation	DA3	DA2	DA1	DA0
Set input mode for lower position address (G0)	L	L	L	L
Wire in	H	L	H	L
Set data input mode	H	L	H	H
Set data output mode	H	H	L	H
Input mode increment	H	H	L	L
Output mode increment	H	H	H	L

Table 3-6 MN1218A control code

In addition to the main 256 bit memory (channel data memory area), a 16 bit last channel memory area is included. This functions to store the channel data for the station selected prior to power on/off.

2) MN1204E guad D/A converter NMOS LSI

The MN1204 is a large scale integrated (LSI) circuit that incorporates a total of four circuits with capacities of 12 bits, 6 bits, 4 bits and 4 bits respectively. In the HR-7600, the 12 bit circuit is employed for obtaining the tuning voltage. The internal counter is controlled by the CPU 4 bit parallel data input (DA0 to DA3). Tuning voltage is produced by 12 bit counter operation to tield a pulse width corresponding to the selected channel.

Consequently, the DAC resolution becomes:

$2^{12} = 4096$ steps

These 4096 steps vary the pulse width during tuning to vary the tuning voltage from 0 to 30 V DC.

$$\frac{30\text{ V}}{4096} = 7.3\text{ mV/step}$$

During the fine tuning process, this 7.3 mV per step is divided (2 bits) by 4, yielding approximately 2 mV per step.

FUNCTIONS

Data Input	4 bit parallel
Output	Pulse width modulated 12 bit counter output
Analog Voltage Resolution	4096 (12 bit control)
Output Pulse Period	3.15 msec
Oscillator Frequency	1.3 MHz

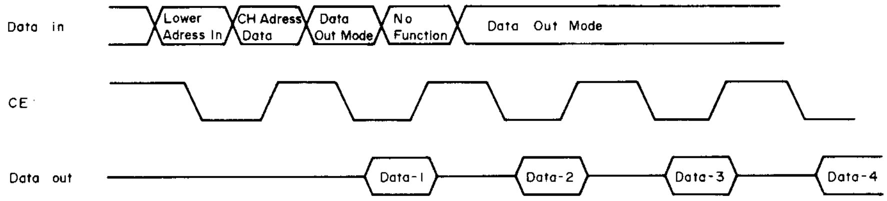

Data in
Lower Adress In
CH Adress Data
Data Out Mode
No Function
Data Out Mode
CE
Data out
Data-1
Data-2
Data-3
Data-4

Fig. 3-45 Read out timing chart

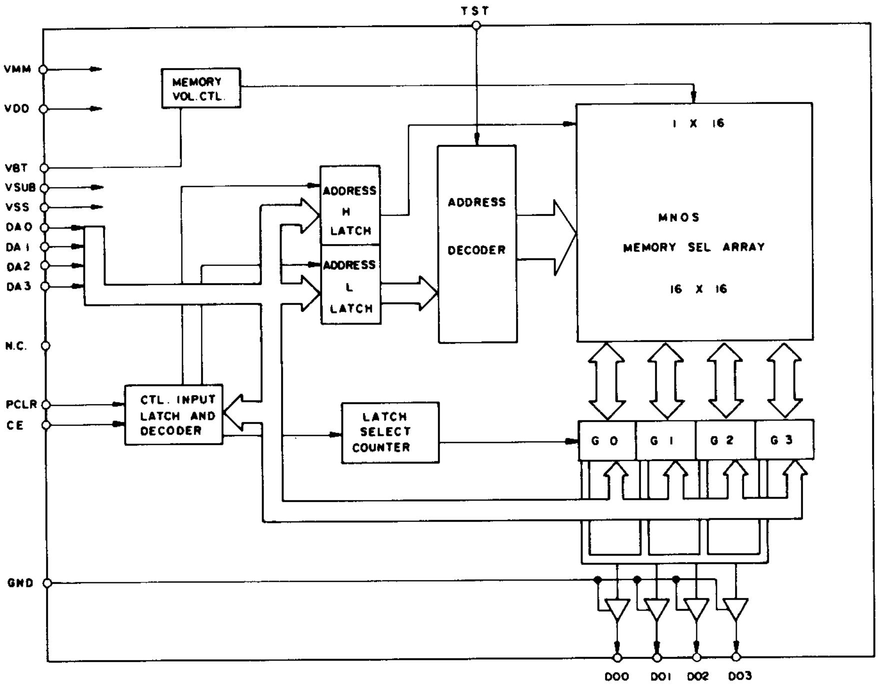

TST
VMM
VDD
VBT
VSUB
VSS
DA0
DA1
DA2
DA3
N.C.
PCLR
CE
GND
MEMORY VOL. CTL.
ADDRESS H LATCH
ADDRESS L LATCH
ADDRESS DECODER
1 X 16
MNOS MEMORY SEL ARRAY
16 X 16
CTL. INPUT LATCH AND DECODER
LATCH SELECT COUNTER
G 0
G 1
G 2
G 3
DO0
DO1
DO2
DO3

Fig. 3-46 MN1218A block diagram

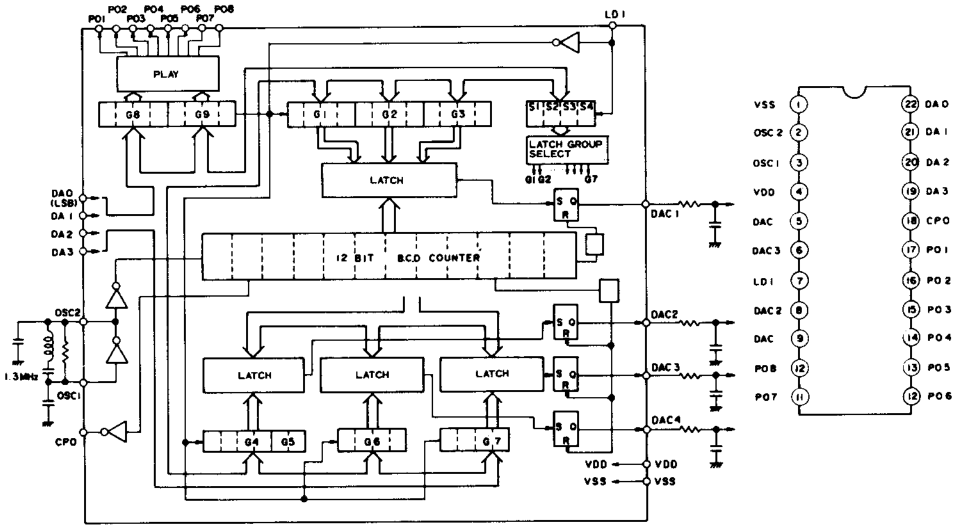

PO1
PO2
PO3
PO4
PO5
PO6
PO7
PO8
LD1
PLAY
G8
G9
G1
G2
G3
S1
S2
S3
S4
LATCH GROUP SELECT
G1 G2
G7
LATCH
DA0 (LSB)
DA1
DA2
DA3
12 BIT B.C.D COUNTER
S Q R
DAC1
DAC2
DAC3
DAC4
OSC2
OSC1
1.3MHz
CPO
LATCH
LATCH
LATCH
G4
G5
G6
G7
VDD
VSS
VSS 1
OSC 2 2
OSC 1 3
VDD 4
DAC 5
DAC 3 6
LD 1 7
DAC 2 8
DAC 9
PO 8 12
PO 7 11
22 DA 0
21 DA 1
20 DA 2
19 DA 3
18 CPO
17 PO 1
16 PO 2
15 PO 3
14 PO 4
13 PO 5
12 PO 6

Fig. 3-47 MN1204E block diagram

3.6.3 Circuit description - 2

1. Reading of key input (Refer to Fig. 3-48.)

   The key input is read by IC206. The key scan data is emitted from pins 9–11 and 13–15 of IC206. The key input data is entered into port K of IC206. The dimmer key is not shown in the figure, since its input data is entered into the display drive IC401.

2. Display data and channel data outputs

   The display data is emitted to port A of IC401 via an inverter from pins 17–20 of IC206.

   Likewise, the channel data is emitted to a port of IC207 via an inverter from pins 17–20 of IC206.

   These data are discriminated by ENABLE signals. Pin 28 of IC206 is assigned as an output pin to DISPLAY DATA ENABLE and pins 22 and 23 of IC206 are assigned as output pins to CH DATA ENABLE.

3. TP202 test point

   When a short-circuit is made between TP202 and TP203 (GND) with an alligator clip or the like, the timer operates at 10 times the normal speed.

4. Channel LED drive

   The channel LEDs are driven by IC207. The channel data is read and processed by port A of IC207. This data is emitted to the cathode side of the LED via an inverter from port G of IC207 and then emitted to the anode side of the LED from port H of IC207.

5. Display drive

   The display is driven by IC401. The display data is fed to port A of IC401 from IC206. This data is then processed by an internal program, thus the filament display is driven by ports E, F, G and I.

6. AC detector

   When a power failure occurs, the timer CPU (MB8851AM-143L) is backed up by the discharging of C266 in the tuner/timer sub-board. However, since the operation of this CPU is assured at more than 3.5 V, the CPU is reset when the discharging voltage of C266 becomes 3.5 V. In addition, the lines to all other elements are cut off to extend the backup time as much as possible.

7. 1/16 count down

   The count pulse (reel FG pulse) is supplied via connector 31 from the mechanism control board. This pulse is waveform-shaped by IC203 and entered to pin 51 of IC211. In IC211, this waveform-shaped pulse is subjected to 1/16 count down and supplied to the CPU (MB8851AM-143L).

3.6.4 Input/output data to each CPU

The input/output data to each CPU is tabulated for reference.

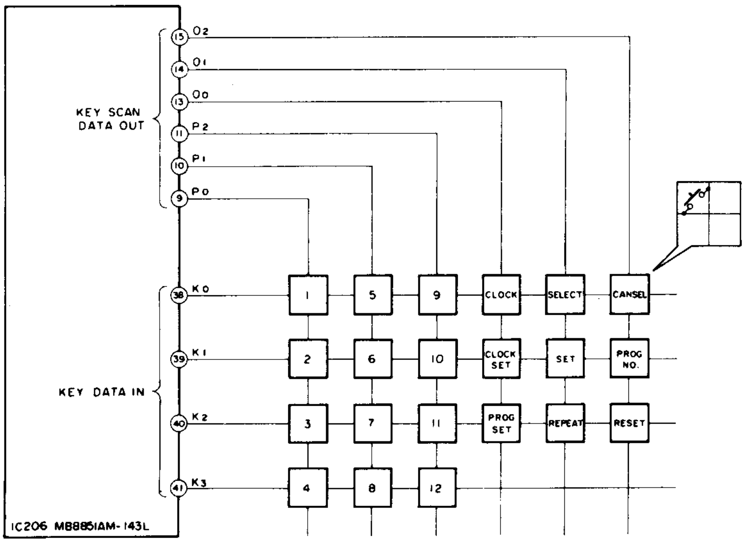


Fig. 3-48 Key scan

PIN No.	PORT		LABEL	CONTENTS
1			OSC IN	X'tal OSC IN 3.84 MHz approx. 8 Vp-p
2			OSC OUT	Power source side of X'tal OSC
3			RESET	RESET PULSE IN
4			–	
5			–	
6			–	
7			COUNT RESET	When the counter is reset, it emits a square-wave of 320 kHz. Resets external frequency-division circuit IC211.
8			–	
9	PORT P	0	SCAN 6	Scan output for KEY SEARCH
10		1	" 5	
11		2	" 4	
12		3	" 3	
13	PORT O	0	" 2	
14		1	" 1	
15		2	" 0	
16		3	CH CAP.	Connected PIN-40 : 12 CH
17		4	DATA 0	Output of DISPLAY DATA and CHANNEL DATA
18		5	" 1	
19		6	" 2	
20		7	" 3	
21			VSS	GND
22	PORT R	0	TUNER CONTROL 0	ENABLE signal output of CHANNEL DATA
23		1	" 1	
24		2	POWER ON (PRE START)	PRE START: High
25		3	REC START	TIMER REC START: High
26		4	COUNT ZERO	Becomes HIGH only when the counter reads "0000".
27		5	NEAR ZERO	0000 ± 100 ⎍ 0000 at counter search mode
28		6	DISPLAY DATA ENABLE	ENABLE signal output of DISPLAY data
29		7	SWD 5 V ON	The electric current is shut off: High
30		8	COUNT PULSE	The COUNT PULSE is entered from IC211.
31		9	REC MODE	REC MODE: Low
32		10	COUNT DOWN	DOWN: Low, UP: High
33		11	TUNER ON	REC SELECT (TUNER): Low
34		12	TIMER ON	Sub-power switch (TIMER): Low
35		13	POWER ON	" (ON): Low
36		14	POWER OFF	MAINS POWER SWITCH (OFF): Low
37		15	TEST	NORMAL: High. For testing the timer connect this pin to GND, and then the timer operates 10 times faster than normal speed.
38	PORT K	0	KEY IN 0	KEY SCAN INPUT
39		1	" 1	
40		2	" 2	
41		3	" 3	
42			VCC	5 V

Table 3-7 IC206 MB8851AM-143L INPUT/OUTPUT Data

PIN No.	PORT		LABEL	CONTENTS
1	CL1		OSC IN	Attached to the outside of the LC resonance circuit for internal clock pulse generation.
2	PORT C	0	CH PRESET MODE	CH PRESET MODE: Low
3		1	DAC BT DOWN	In the Channel Preset mode, the comparator output is entered from pin 7 of IC204.
4		2	BAND DATA BV	Band select switch (VHF): Low at CH preset mode
5		3	BAND DATA BU	" (UHF): Low "
6	INT		DATA STORE	PRESET input after tuning
7	RST			RESET IN
8	PORT D	0	BT AND BAND DATA 3	Read-out data input from IC205
9		1	" 2	
10		2	" 1	
11		3	" 0	
12	PORT E	0	BT AND BAND DATA 3	Write-in data output to IC202 and IC205
13		1	" 2	
14		2	" 1	
15		3	" 0	
16	PORT F	0	DATA ENABLE	Chip ENABLE output to IC205
17		1	"	Chip ENABLE output to IC202
18		2	CH PRESET INDICATOR ON	Output to preset indicator
19		3	–	
20	TST			10 V
21	Vss			10 V
22	PORT G	0	CH INDICATOR LED K0	CH INDICATOR LED CONTROL OUT
23		1	" K1	
24		2	" K2	
25		3	" K3	
26	PORT H	0	CH INDICATOR LED A0	
27		1	" A1	
28		2	" A2	
29		3	" A3	
30	PORT I	0	–	Sound mute output when changing channels or when skipping a channel
31		1	MUTE	
32		2	"	
33	PORT A	0	CTL DATA 3	Data input from timer control
34		1	" 2	
35		2	" 1	
36		3	" 0	
37	PORT B	0	CTL CODE 0	
38		1	" 1	
39		2	CH DOWN	
40		3	CH UP	Sequential channel switching input
41	VGG		Vgg	GND
42	CL0		OSC OUT	Attached to the outside of the LC resonance circuit for internal clock pulse generation.

Table 3-8 IC207 UPD552C-088 INPUT/OUTPUT Data

PIN No.	PORT		LABEL	CONTENTS
1	CL1		OSC IN	
2	PORT C	0	TEST 0	–
3		1	" 1	
4		2	" 2	
5		3	" 3	
6	INT			
7	RST			
8	PORT D	0	–	–
9		1	–	
10		2	–	
11		3	–	
12	PORT E	0	Dig 9	DISPLAY DATA OUT
13		1	2nd	
14		2	Dig 8	
15		3	1st	
16	PORT F	0	Dig 7	
17		1	Day	
18		2	Dig 6	
19		3	Dig 5	
20	TST		TEST	
21	Vss		Vss	10 V
22	PORT G	0	Dig 1	DISPLAY DATA OUT
23		1	Seg a	
24		2	" b	
25		3	" d	
26	PORT H	0	Dig 2	
27		1	Seg c	
28		2	Dig 3	
29		3	Seg e	
30	PORT I	0	Dig 4	
31		1	Seg g	
32		2	Seg f	
33	PORT A	0	DATA 0	DISPLAY DATA IN
34		1	" 1	
35		2	" 2	
36		3	" 3	
37	PORT B	0	DATA ENABLE	DISPLAY DATA ENABLE
38		1	–	
39		2	DIMMER	DIMMER SWITCH ON: Low
40		3	12H/24H	24H: High, 12H: Low
41	VGG		Vgg	GND
42	CLo		OSC OUT	

Table 3-9 IC401 UPD552C-079 INPUT/OUTPUT Data

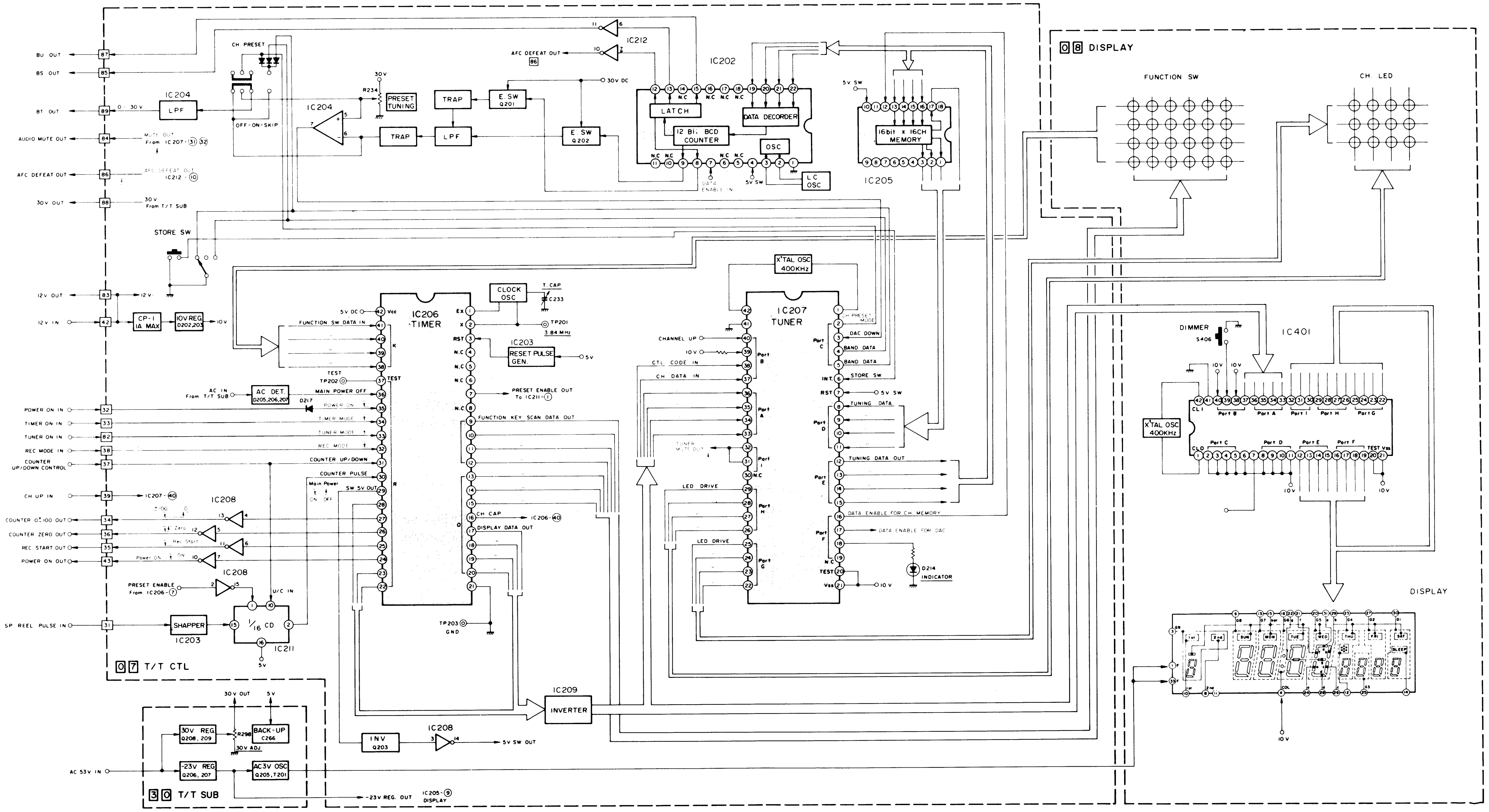

BU OUT
BS OUT
BT OUT
AUDIO MUTE OUT
AFC DEFEAT OUT
30V OUT
12V OUT
12V IN
POWER ON IN
TIMER ON IN
TUNER ON IN
REC MODE IN
COUNTER UP/DOWN CONTROL
CH UP IN
COUNTER 0/100 OUT
COUNTER ZERO OUT
REC START OUT
POWER ON OUT
SP REEL PULSE IN
CH PRESET
IC204
LPF
OFF-ON-SKIP
PRESET TUNING
R234
TRAP
LPF
E SW
Q201
E SW
Q202
30V DC
AFC DEFEAT OUT
IC212
IC202
LATCH
DATA DECORDER
12 Bi. BCD COUNTER
OSC
LC OSC
DATA ENABLE IN
5V SW
16bit x 16CH MEMORY
IC205
STORE SW
CP-1 1A MAX
10V REG
D202,203
AC DET
D205,206,207
D217
IC206
TIMER
CLOCK OSC
T. CAP
C233
TP201
3.84 MHz
IC203
RESET PULSE GEN.
PRESET ENABLE OUT To IC211-①
FUNCTION KEY SCAN DATA OUT
FUNCTION SW DATA IN
MAIN POWER OFF
COUNTER UP/DOWN
COUNTER PULSE
SW 5V OUT
CH CAP
DISPLAY DATA OUT
TP203
GND
X'TAL OSC 400KHz
IC207
TUNER
CHANNEL UP
CTL CODE IN
CH DATA IN
TUNER MUTE OUT
LED DRIVE
CH PRESET MODE
DAC DOWN
BAND DATA
STORE SW
TUNING DATA
TUNING DATA OUT
DATA ENABLE FOR CH MEMORY
DATA ENABLE FOR DAC
D214 INDICATOR
IC208
IC208
PRESET ENABLE From IC206-⑦
U/C IN
SHAPPER
IC203
1/16 CD
IC211
07 T/T CTL
IC209
INVERTER
30V OUT
5V
30V REG
Q208, 209
R298
30V ADJ
BACK-UP
C266
-23V REG
Q206, 207
AC3V OSC
Q205, T201
AC 53V IN
INV
Q203
IC208
5V SW OUT
-23V REG. OUT
IC205-⑨ DISPLAY
30 T/T SUB
08 DISPLAY
FUNCTION SW
CH LED
DIMMER
S406
IC401
X'TAL OSC 400KHz
Port B
Port A
Port I
Port H
Port G
Port C
Port D
Port E
Port F
DISPLAY
SUN
MON
TUE
WED
THU
FRI
SAT
SLEEP
10V

Fig. 3-49 Tuner/Timer control and display block diagram

3.6.5 Overall operation check

Timer control section

Item check	Procedure	Operation check
(1) Power failure indication	● Set MAINS POWER switch ON (after OFF for over 2 hours).	● 0.5 sec. later, "SUN 0:00" blinks. ● CH No. indicator goes out.
(2) MAINS POWER switch ON	● Set sub-power switch ON.	● Sub-power indicator lights. CH No. indicator lights. ● "SUN 0:00oooo" blinks.
(3) Clock setting	● Press CLOCK SET button.	● "SUN 0:00oo" appears. Second counting starts. Second indicator blinks.
(4) Second setting	● Press SET button.	● Blinking stops. Second is reset (29 or less is rounded to "0" second and 30 or more is to rounded to next minutes. ● While pressing button, time-keeping is not performed.
(5) Minute setting	● Press SELECT button. ● Press SET button.	● Minute indicator blinks. ● Blinking stops. ● Whenever button is pressed, minute advances. When continue pressing for more than 1 second, minute changing is speeded up at rate of 6 digits/sec. ● Minute is not carried over to hr. (00 → 59 → 00)
(6) Hour setting	● Press SELECT button. ● Press SET button.	● Hour indicator blinks. ● Blinking stops. ● Whenever button is pressed, hour advances. When continue pressing for more than 1 second, hour changing is speeded up at rate of 6 digits/sec. ● Hour is not carried over to day.
(7) Day setting	● Press SELECT button. ● Press SET button.	● Day indicator blinks. ● Blinking stops. ● Whenever button is pressed, day changes. When continue pressing for more than 1 second, day changing is speeded up. (SUN → SAT → SUN)
(8) Second setting	● Press SELECT button.	● Return to item (3).
(9) Automatic return to clock setting	● Leave timer alone with clock having been set.	● 1 to 2 minutes later, display returns to Clock mode. ● Display changes from seconds to time-keeping.
(10) Program setting	● Press PROGRAM SET button.	● Display changes to program. Program No. : 1 appears. CH No. : 1 (blinking) Day : 1st SUN Time : 0:00 Recording length: ooo
(11) Channel setting for recording	● Press SET button.	● Blinking stops. ● Whenever button is pressed, Channel Number changes. ● When continue pressing for more than 1 second, CH No. changing is speeded up at rate of about 4 digits/sec. ● Skipping is not possible. (1 → 12 → 1)

Item check	Procedure	Operation check
(12) Day setting for recording to start	● Press SELECT button. ● Press SET button.	● 1st SUN blinks. ● Blinking stops. ● Whenever button is pressed, day changes. ● When continue pressing for more than 1 second, day changing is speeded up. (1st SUN → 1st SAT → 2nd SUN → 2nd SAT → 1st SUN . . . 2nd SAT → 1st SUN)
(13) Record (switch on) time (hour digits)	● Press SELECT button. ● Press SET button.	● Same as item (6). ● Same as item (6).
(14) Record (switch on) time (minute digits)	● Press SELECT button. ● Press SET button.	● Same as item (5). ● Same as item (5).
(15) Recording length	● Press SELECT button. ● Press SET button.	● 3 digits for recording length blink. ● Blinking stops. ● Whenever button is pressed, length increases in 5-minute increments. ● When continue pressing for more than 1 second, length indication changing is speeded up. (000 → 395 → 000)
(16) Channel to be recorded	● Press SELECT button.	● Set to channel to be recorded and return to (11).
(17) Repeat setting	● Press REPEAT button.	● Repeat indication appears. ● The corresponding program is repeated per entered data.
(18) Program Number setting	● Press PROGRAM No. button.	● Whenever button is pressed, Program No. changes. (1 → 8 → 1)
(19) Cancellation of entered data	● Press CANCEL button.	● Contents of displayed program is cancelled. Return to item (10). (However, Program No. does not change.)
(20) Automatic cancelling of entered data	● Press PROGRAM No. button and CANCEL button is simultaneously.	● Contents of programs 1–8 are all cancelled. Return to item (10).
(21) Automatic return to clock setting	● Leave timer alone with program having been set.	● 1 to 2 minutes later, timer returns to Clock mode.
(22) Program data becomes void.		● When recording length is not set, the corresponding program setting becomes void.
(23) Program priority		● Among the programs preset for same time, the one with smaller Program No. is given priority. ● When preset program times overlap the earlier-started program will be interrupted by the latter one.
(24) Timer operation	● Set Sub-power switch to TIMER. ● 10 seconds before specified time.	● Timer indicator lights. ● Power ON indicator goes out. ● CH No. indicator goes out. ● Counter display disappears. ● Power ON indicator lights. ● Counter display turns ON. ● Specified CH No. indicator lights. ● In recording mode, machine enters into loading pause mode. (Pre-start output is emitted.)

Item check	Procedure	Operation check
(24) Timer operation (continued)	• Specified time is reached.	• Pause is released. Recording starts. (Recording-start output is emitted.)
(25) Program check during recording	• Press PROGRAM SET button. • In case of program being recorded (Press SELECT button.) • In case of program other than the one being recorded.	• Clock changes to program display. • For a program being recorded, only the length can be corrected. 1. Recording length > elapsed time → recording is continued. 2. Recording length ≦ elapsed time → recording is cancelled within 2 minutes. • Same as in normal PROGRAM SET condition.
(26) Completion of recording	• Recording-start time plus recording length	• Pre-start output and recording-start output turn OFF simultaneously. • When not in Repeat mode, program data are cancelled within 1 minute.
(27) Continued program recording		• Program recording continues when preset times overlap. Pre-start operation is not performed.
(28) Timer sleep operation	• Set Sub-power switch to TIMER during recording. • Press SELECT button.	• "SLEEP" lights on counter display. • Recording length indicator shows 60 minutes. • Only recording length can be changed. • 60 → 395 → 0 → 395 • Same as in normal PROGRAM SET condition.
(29) Program setting with Sub-power switch OFF	• Press PROGRAM SET button.	• Same as in normal PROGRAM SET condition.
(30) Channel selection during recording		• Channel is locked during recording. • Channel selection can be made in Pause mode.
(31) Carry-over data		• In the Clock mode, each digit should be carried over to the next. (Example) SAT 23-hr 59-min → SUN 0-hr 00-min

Tuner control section

Item check	Procedure	Operation check
(1) Channel setting	● Set CH (PRESET) switch to ON. ● Set Band switch correctly. ● Turn the tuning control knob.	● About 1 second later, (CH SET) indicator lights. ● AFC is defeated. ● Band changes according to setting of band switch. ● Tuning voltage (BT) changes according to the turning of the tuning control knob.
(2) Store	● Push STORE knob.	● After (CH SET) indicator blinks for about 2 seconds, preset channel is stored in memory.
(3) Skip setting	● Set the PRESET switch to SKIP. ● Push STORE knob.	● Displayed channel will be skipped. However, CH No. 1 cannot be skipped.
(4) Skip cancel	● Perform channel setting procedures again.	● Skip is cancelled.
(5) Last channel memory	● Select a channel. ● Sub-power switch OFF → ON	● Selected channel Number indicator lights. ● After power ON, same channel Number indicator lights.
(6) Sound mute	● Change channels.	● Sound mute should function.
(7) AFC defeat	● Change channels.	● AFC turns OFF (defeated).
(8) AFC ON/OFF	● Set AFC switch ON. ● Set AFC switch OFF.	● AFC turns ON. ● AFC turns OFF (defeated).
(9) Channel memory	● Turn MAINS POWER switch OFF and ON.	● Stored data should not change.

Tape counter section

Item check	Procedure	Operation check
(1) Counting operation	● Count the number of pulses input.	● Displayed figure is 1/16 of number of count pulses.
(2) UP/DOWN counting	● Run the tape in the forward direction. ● Rewind the tape.	● Count-up is performed. ● Count-down is performed.
(3) Reset	● Press COUNTER RESET button.	● Counter is reset to zero. ● Valid only when counter is displayed.
(4) Counter output	● Set counter to zero. ● ±100 count UP : 9900–9999 DOWN : 0099–0	● Zero output is emitted. (0 = L) ● Count output is emitted. (0 ± 100 or less = L)
(5) Counter accuracy	● In count UP/DOWN, input of same number of pulses	● ±1 count or less

Remote control operation

Check item	Procedure	Operation check
(1) Channel changing	• Press the TV PROG. button.	• Channels change upward. • When continue pressing, channels change upward at rate of about 0.5 Hz/sec.

Display section

Check item	Procedure	Operation check
(1) Dimmer operation	• Press DIMMER button. (Make visual check.) • Press DIMMER button again.	• Brightness lowers. • Brightness should be consistant for all display information. • Brightness becomes normal level as before.
(2) Irregular brightness	• Make a visual check.	• Brightness should be consistant for all display information.
(3) Button operation		• Each button should function by applying moderate pressure.
(4) Pressing various buttons at the same time	• Press combinations of buttons not prescribed for simultaneous operation.	• Abnormal operation should not occur.

SECTION 4
MECHANICAL ADJUSTMENT

4.1 GENERAL

4.1.1 Precautions

IMPORTANT:

1. Disconnect from power before removing or soldering components.
2. When removing a screw from the chassis, be careful not to drop it into the mechanism. If a screw should be dropped, be sure to retrieve it.
3. Be extremely careful not to damage either the upper or lower head drum assemblies.
4. The tape transport mechanism has been precisely adjusted at the factory and ordinarily does not require readjustment.
5. When removing a part, be very careful not to damage or displace other parts. (Be especially careful with the guide poles and rotary video head drum.)
6. The cassette switch is mounted to the cassette housing. Therefore, the set cannot be operated without the cassette housing (i.e., while cap housing of the cassette housing is disengaged). Therefore, to operate the set without the cassette housing, set the cassette switch short jig (part no. PUJ43068) so as to press the cap housing inward. Also disable the photo transistor sensors by applying opaque covers. After completing checks and repairs, be sure to remove the covers.
7. When raising the set on its side, it is better for stability not to remove the front panel.
8. Tighten the screws carefully to avoid damage to the cabinet.

4.1.2 Required jigs and tools

For proper mechanical adjustment, the following jigs and tools are strongly recommended. Without them, a long trial-and error period would be necessary.

In addition, general-purpose tools and a metric hex key (not supplied by JVC) are required.
The hex key needed for this model is 1.5 mm size.

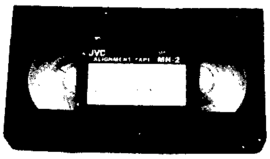
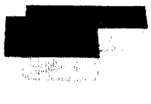
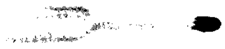
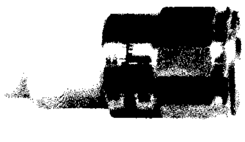
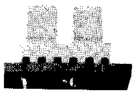
JVC Alignment tape MH-2 	Master plane jig PUJ42146 	Height gauge PUJ42147-2 	JVC oil PU41761 
Torque gauge ass'y PUJ48075-2 (Torque meter 600ATG Torque gauge head PUJ48016-2 	Back tension cassette gauge PUJ48076 	Cassette switch short jig PUJ43068 	Audio/Control head position tool PUJ47351-2

Table 4-1 Jigs and tools

NOTE: See section 5.1 required test equipment and jigs regarding electrical adjustment.

4.1.3 Disassembly

A: External covers

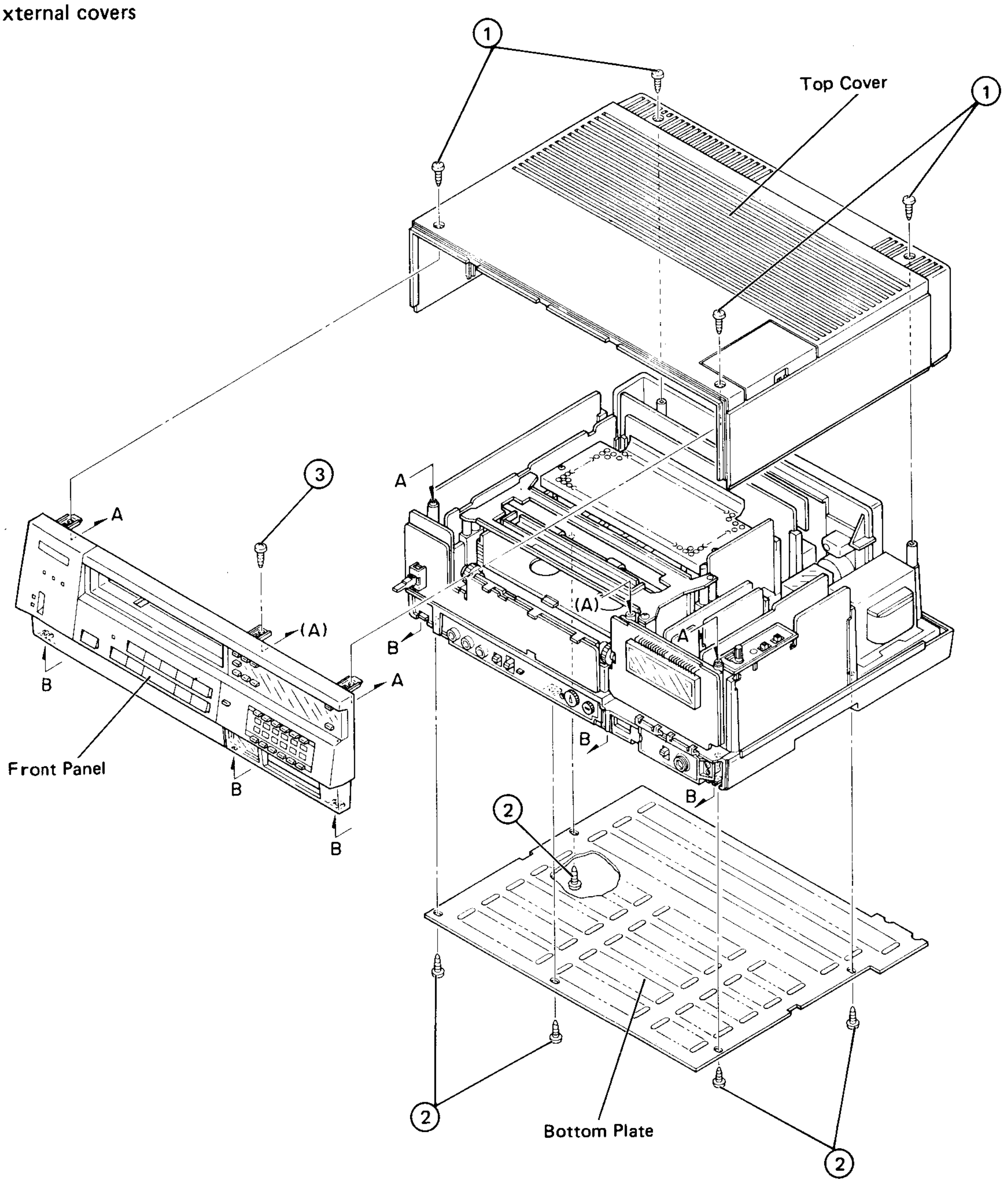


Fig. 4-1(a) External covers

1. Take out four screws ① and remove the top cover.
2. Take out five screws ② and remove the bottom plate.
3. To remove the front panel, take out one screw ③. As shown in Fig. 4-1 (a), the front panel is held by plastic post structures at two points A and three points B. Slightly raise the front panel to disengage points A, pull the panel outward by a small amount, then apply downward pressure to disengage points B. Afterwards, pull the panel gently outwards to remove.
4. To reassemble, reverse the above steps. Observe that points A and B are properly re-engaged.

B: Circuit board assemblies

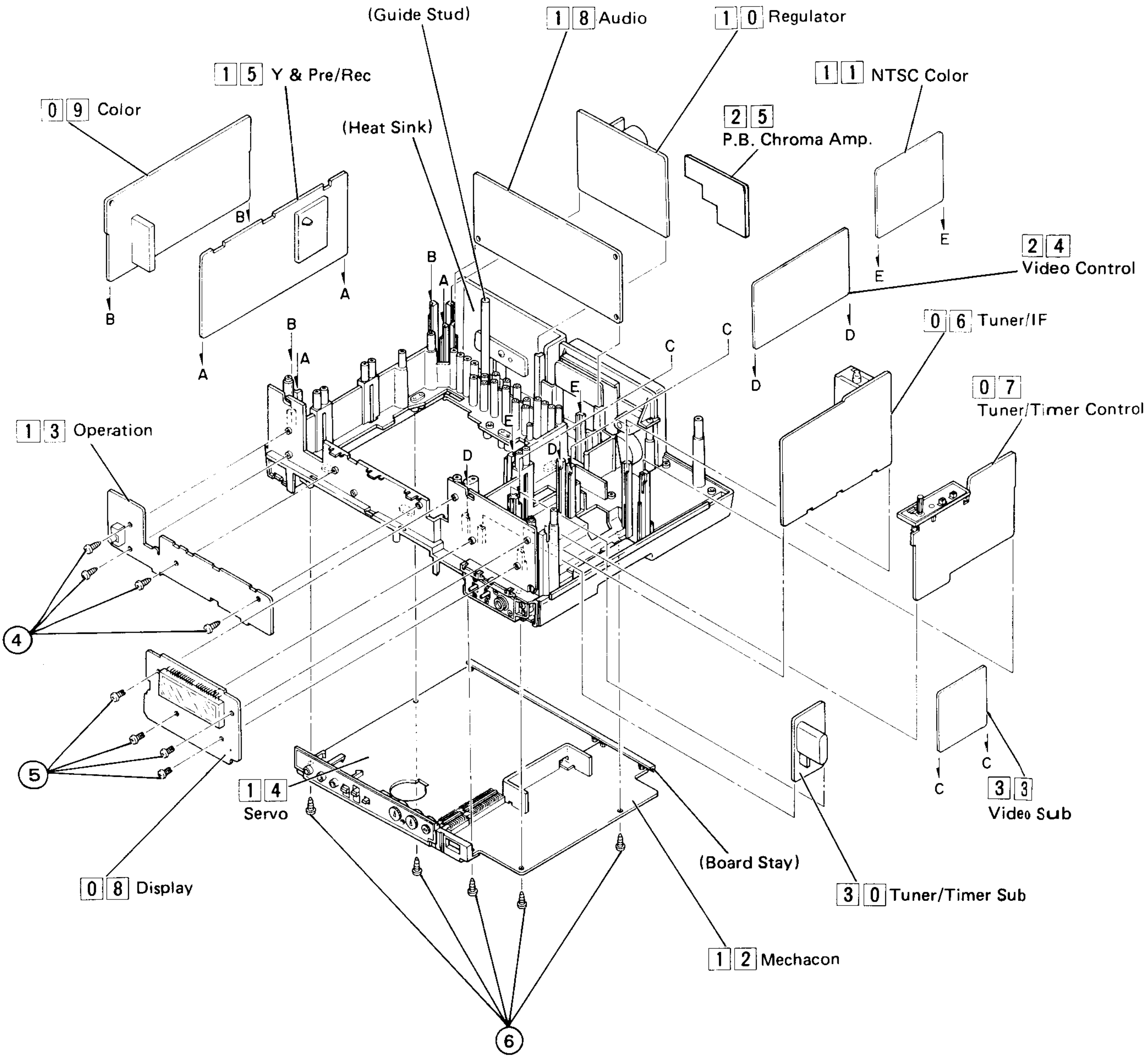

(Guide Stud)
18 Audio
10 Regulator
15 Y & Pre/Rec
11 NTSC Color
09 Color
(Heat Sink)
25 P.B. Chroma Amp.
24 Video Control
06 Tuner/IF
07 Tuner/Timer Control
13 Operation
A
B
C
D
E
4
5
14 Servo
08 Display
(Board Stay)
33 Video Sub
30 Tuner/Timer Sub
12 Mechacon
6

Fig. 4-1(b) Circuit boards

1. Operation board assembly
   Take out four screws ④ and remove the operation board assembly.
2. Display board assembly
   Take out four screws ⑤ and remove the display board assembly.
3. Servo and Mechacom board assemblies
   Take out five screws ⑥ and remove the board stay from the chassis assembly.
4. P.B. Chroma Amp. board assembly
   Pull the P.B. chroma Amp board upward from the main deck assembly board guide.
5. Other board assemblies
   Remove the Clolr, Y & Pre/Rec, Regulator, Audio, Video Control, NTSC color, Tuner/IF, Tuner Timer Control, Video Sub and Tuner/Timer sub board assemblies by pulling them upward from the cassis assembly board guides.
6. Heat sink
   The heat sink, with power transistor and servo power transistor boards, can be removed by pulling it upward from the guide stud of the chassis assembly.

4.1.4 Layout of main mechanical parts

A: Top view and parts identification

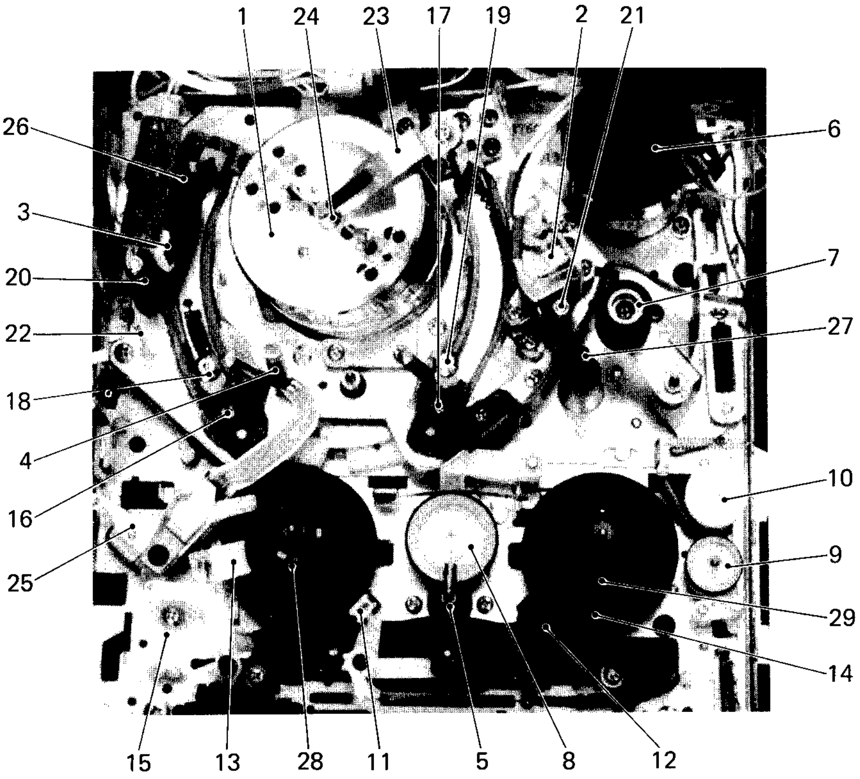


Fig. 4-2(a) Top view

Category	Symbol No.	Part Name	Part No.	Category	Symbol No.	Part Name	Part No.
A	1	Upper drum ass'y	PU31332L	E	16	Supply pole base ass'y	PU48740B
	2	Audio/Control head ass'y	PU51903		17	Take-up pole base ass'y	PU48745B
	3	Full erase head	PU51263-2		18	Supply guide roller ass'y	PU48748B
	4	Cue head (Tension pole)	PU49654		19	Take-up guide roller ass'y	PU48748B
B	5	Reel motor ass'y	PU53577V		20	Supply guide pole	PU53826
					21	Take-up guide pole	PU53826
	6	Capstan motor ass'y	See table 4-2 (b) 51		22	Supply guide pin	Included in sub deck ass'y
C	7	Pinch roller ass'y	PU51367A	F	23	Brush ass'y	PU48678A
	8	Reel idler ass'y	PU48967B		24	Commutator	PU49483
	9	Take-up idler ass'y	PU51402		25	Tension arm	PU52267
	10	Take-up clutch ass'y	PU53462A		26	Impedance roller ass'y	PU51292A
D	11	Supply main brake	PU50713		27	Capstan flywheel ass'y	See table 4-2 (b) 60
	12	Take-up main brake	PU50671		28	Supply reel disk ass'y	PU48907D
	13	Loading tension brake	PU51384		29	Take-up reel disk ass'y	PU48907E
	14	Take-up back tension brake	PU51524				
	15	Tension band ass'y	PU51390A				

A: Heads B: Motors C: Rubber parts D: Brakes and band

E: Poles, rollers and pin F: Others

Main brakes............ Not incl. brake shoes (PU50670) .
Tension brakes........ Not incl. Pads (PUM30019-2).

Table 4-2(a) Top view main part list

B: Bottom view and parts identification

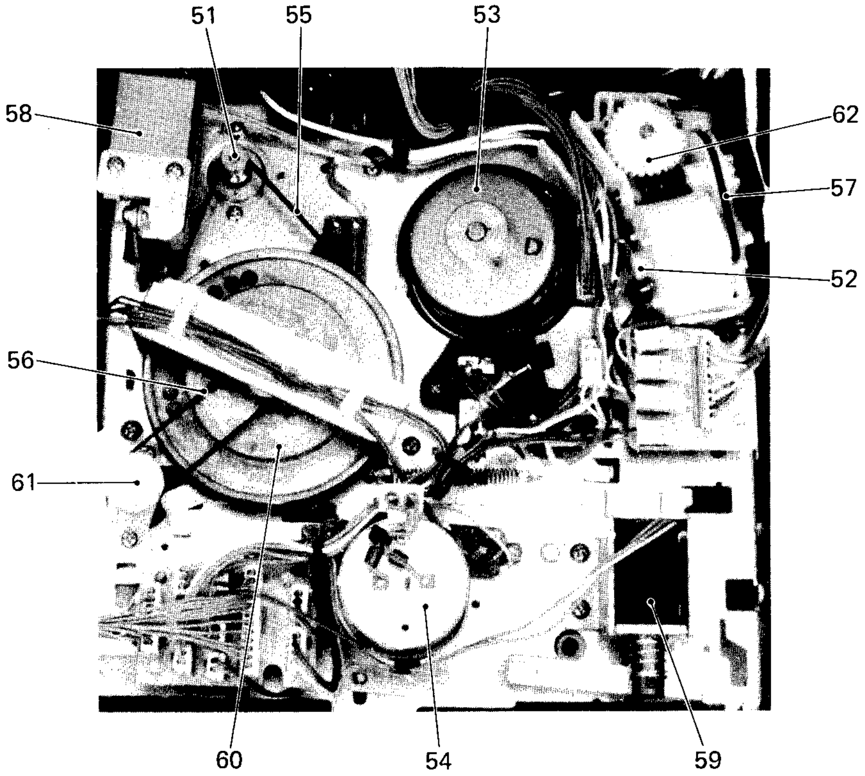


Fig. 4-2(b) Bottom view

Category	Symbol No.	Part Name	Part No.
G	51	Capstan motor ass'y	PU53994P
	52	Loading motor ass'y	PU52503A
	53	Lower drum ass'y	PUS36293F
	54	Reel motor ass'y	See table 4-2(a) 5
H	55	Capstan belt	PU49164
	56	Take-up clutch belt	PUM30003-1
	57	Loading belt	PU50350
I	58	Pinch roller solenoid	PU51900-1-2
	59	Brake solenoid	PU51873-1-2
J	60	Capstan flywheel ass'y	PU33265D
	61	Take-up clutch ass'y	See table 4-2(a) 10
	62	Loading gear ass'y	PU51859A-2
		(Incl. motor, belt, capacitor and screw for motor)	

G: Motors H: Rubber parts I: Solenoid J: Others

Table 4-2(b) Bottom view main parts list

4.2 PERIODIC MAINTENANCE

The following procedures are recommended for maintaining optimum performance and reliability of this video cassette recorder.

4.2.1 Cleaning

For cleaning, use a lint-free cloth or gauze dampened with alcohol.

A: Tape transport system

1. The following components should be cleaned after every 500 hours of use.
   1) Supply guide pin
   2) Cue head (Tension pole)
   3) Supply guide pole
   4) Full erase head
   5) Impedance roller
   6) Supply guide roller
   7) Supply slant pole (Supply pole base assembly)
   8) Video head and Drum system
   9) Commutator
   10) Brush
   11) Take-up slant pole (Take-up pole base assembly)
   12) Take-up guide roller
   13) Audio/Control head and Audio erase head
   14) Take-up guide pole
   15) Pinch roller
   16) Capstan
2. Since above parts come in direct contact with video tape, they tend to collect dust particles. If allowed to accumulate, dust may lead to damage to the video tape and above parts.
3. After cleaning with alcohol, allow the parts to dry thoroughly before using a cassette tape.

NOTE:
When cleaning the two video heads on the upper drum, do not clean them with a vertical stroke.
Use only a gentle back and forth motion in the direction of the tape path.
Use care since they are easily damaged.
When cleaning video heads, A/C head and erase heads, use a lint-free cloth dampened with alcohol.

B: Reel drive system

1. The following components should be cleaned after every 1,000 hours of use.

   – Upper section –
   17) Reel motor
   18) Reel idler
   19) Supply reel disk
   20) Supply main brake
   21) Take-up reel disk
   22) Take-up main brake
   23) Take-up clutch
   24) Take-up idler

   – Bottom section –
   25) Capstan motor
   26) Capstan belt
   27) Capstan flwheel
   28) Take-up clutch belt
   29) Take-up clutch
   30) Loading gear
   31) Loading belt
   32) Loading motor

   – Cassette housing section –
   33) Rollers of roller assembly
   34) Cassette belt
   35) Cassette motor
2. The above revolving parts are of rubber or come in direct contact with rubber parts.
   Rubber dust can accumulate and interfere with proper operation.
3. Avoid using excessive alcohol when cleaning rubber parts.

4.2.2 Lubrication

The following components should be lubricated with JVC oil after every 2,000 hours of use.

1) Shaft of the supply reel disk
2) Shaft of the take-up reel disk

After cleaning above shafts with alcohol, lubricate these shafts with one or two drops of JVC oil.
Do not over lubricate.

4.2.3 Service schedule for main components

The following chart lists the parts of the units which should receive periodic servicing at the recommended intervals.

Name	Periodic Service Schedule (operating hours)				
	1 000	2 000	3 000	4 000	5 000
Upper drum assembly	○	●	○	●	○
Brush assembly and commutator		●		●	
Cassette motor assembly			●		
Cassette belt		●		●	
Roller assembly (for cassette housing)		●		●	
Take-up clutch assembly		●		●	
Take-up clutch belt		●		●	
Take-up idler assembly		●		●	
Reel motor assembly		●		●	
Reel idler assembly		●		●	
Capstan motor assembly		●		●	
Capstan belt		●		●	
Loading motor			●		
Loading belt		●		●	
Audio/Control head assembly			●		
Tension band assembly		●		●	
Supply reel disk assembly			●		
Take-up reel disk assembly			●		
Loading tension brake pad		●		●	
Take-up back tension brake pad		●		●	
Pinch roller assembly			●		
Cue head					●
Full erase head					●

Table 4-3 Standard service periods

○ Check and replace if necessary.

● Replace.

NOTE:

Even if the unit is not used frequently, cleaning, lubrication and replacement of the belts should be undertaken every 2 years.

4.3 MAIN ASSEMBLY REPLACEMENTS

4.3.1 Cassette housing assembly, cassette motor assembly and cassette switch

A: Cassette housing assembly

1. Remove the top cover and front panel.
2. Take out four screws Ⓐ and disconnect the cap housing (see Fig. 4-3). Carefully lift the cassette housing upward to remove it. During reaasembly, use care that the record safety arm does not damage the leaf switch.

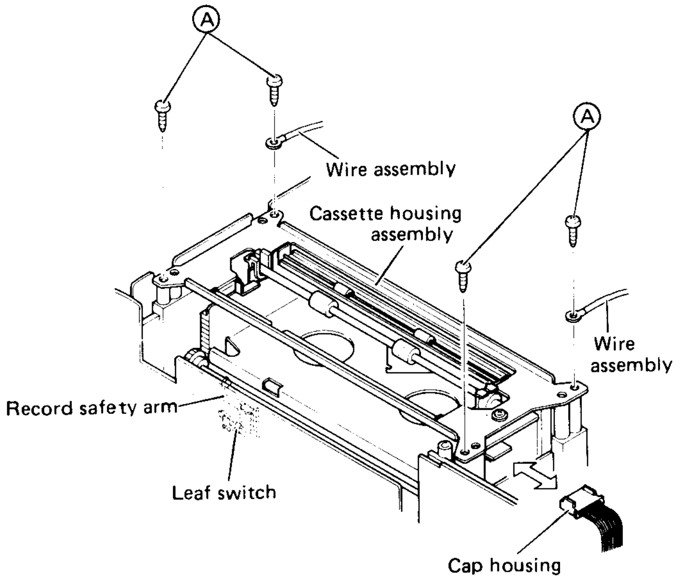

Ⓐ
Wire assembly
Cassette housing assembly
Ⓐ
Wire assembly
Record safety arm
Leaf switch
Cap housing

Fig. 4-3 Cassette housing removal

3. To reinstall the cassette housing, first connect the cap housing. Gently set the cassette housing into the main deck while using care that the record safety arm does not damage the leaf switch. Check that the housing is properly engaged at points A, B, C and D as indicated in Fig. 4-4.

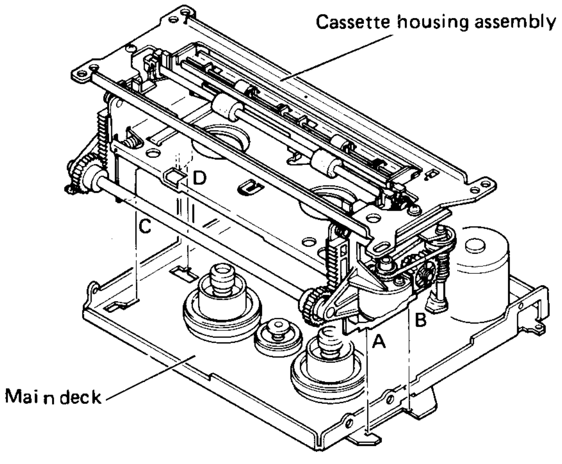

Cassette housing assembly
D
C
B
A
Main deck

Fig. 4-4 Cassette housing setting

4. Insert the four screws Ⓐ , shown in Fig. 4-3 (also reattach the two wire assemblies), but do not tighten the screws.
5. Shift the cassette housing so that points C and D (Fig. 4-4) are at their most rearward (toward the drum assembly) positions, then tighten the four screws Ⓐ.
6. Use a cassette tape and check for smooth operation of the cassette housing assembly. Also confirm operation of the record safety arm.

   NOTE: The cassette switch is mounted on the cassette housing. For this reason, the set becomes inoperative when the cassette housing is removed (cap housing disconnected).

B: Cassette motor assembly

1. Unsolder the cassette motor wires.

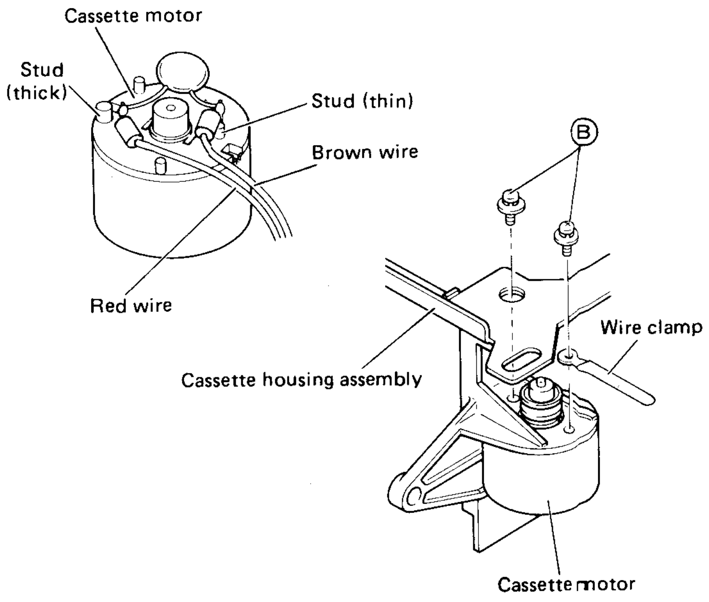

Cassette motor
Stud (thick)
Stud (thin)
Brown wire
Red wire
Ⓑ
Wire clamp
Cassette housing assembly
Cassette motor

Fig. 4-5 Cassette motor replacement

2. Disengage the belt from the motor pulley, take out two screws Ⓑ and remove the cassette motor. See Fig. 4-5.
3. Reinstall the cassette motor with the two screws Ⓑ, together with the wire clamp, then reengage the belt.
4. Solder the wire coming from connector 1 of the cap housing to the cassette motor terminal adjacent to the thicker diameter stud. This is the minus (—) terminal. Observe that wires do not contact rotating parts.
5. Use a cassette tape and check for smooth operation of the cassette housing assembly. Confirm operation of the record safety arm.

C: Cassette switch

1. Unsolder the cassette switch wires.

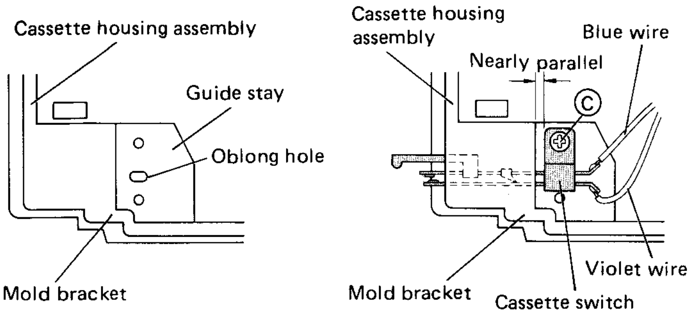
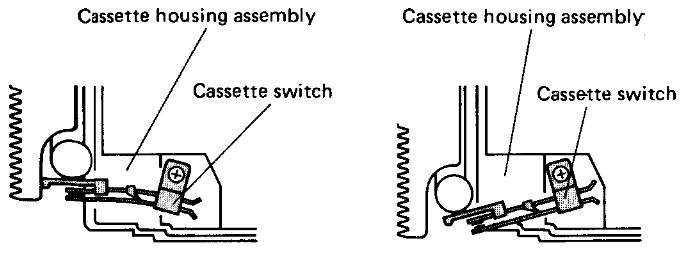

Cassette housing assembly
Guide stay
Oblong hole
Mold bracket
Cassette housing assembly
Blue wire
Nearly parallel
Ⓒ
Violet wire
Mold bracket
Cassette switch

Fig. 4-6 Cassette switch replacement

2. Take out one screw Ⓒ and remove the cassette switch toward the right. See Fig. 4-6.
3. When reinstalling the cassette switch, use care not to damage the contacts. Insert the cassette switch toward the left and engage the stud at the rear of the switch with the oblong hole of the guide stay. Position the switch so that is nearly parallel with the mold bracket, as shown in Fig. 4-6, then secure with screw Ⓒ.
4. Resolder the cassette switch wires.

NOTE:
When the cassette switch closes, short brake is applied to the cassette motor, stopping rotation. Consequently, the mounting position of the switch determines the cassette setting position. After the cassette housing has been installed at the correct position, perform the following checks and readjust the cassette switch position as required.

1) Supply power and insert a cassette. Observe the cassette lowering and setting operation. Check for the following symptoms.
2) Cassette position too high
In this case, the switch contacts are too high, as indicated in Fig. 4-7 (a). The switch closes (on state) before the cassette has been fully lowered. Test by gently pressing the cassette by hand to determine whether it can be lowered further.


Cassette housing assembly
Cassette switch
Cassette housing assembly
Cassette switch

(a) Too high (b) Too low

Fig. 4-7 Cassette switch adjustment

3) Eject mode entered
After the cassette motor rotates, if the cassette switch does not close within about 7 seconds, the eject mode is automatically entered. This effect can be caused if the switch contacts are positioned too low, as shown in Fig. 4-7 (b). At this time, even though the cassette is fully lowered, the cassette switch contacts do not close.
4) Rebound effect
After reaching the bottom of travel, the cassette rebounds slightly upward. In this case, there is a slight delay between maximum lowering and cassette switch closing. Residual tension of the cassette belt then pulls the cassette slightly upward.
5) If any of the above effects is observed, adjust the cassette switch position to obtain precise timing between the end of cassette travel and cassette switch closing.
6) Use a cassette tape and check for smooth operation of the cassette housing assembly. Confirm functioning of the record safety arm.

4.3.2 Upper drum, brush assembly and commutator

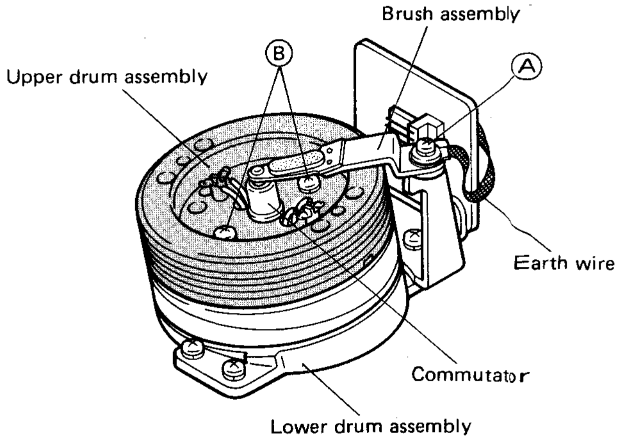

Brush assembly
Ⓑ
Ⓐ
Upper drum assembly
Earth wire
Commutator
Lower drum assembly

Fig. 4-8 Upper drum replacement

1. Take out screw Ⓐ , disconnect the earth wire and remove the brush assembly. See Fig. 4-8.
2. Remove the commutator from the drum motor shaft.

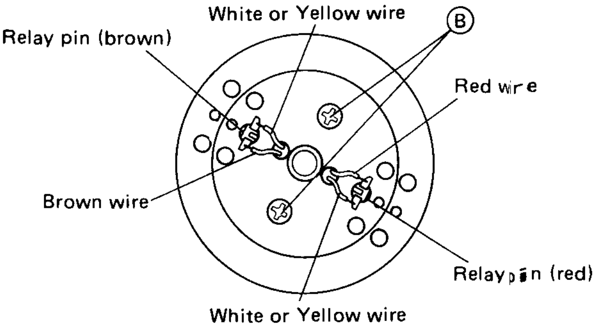

White or Yellow wire
Ⓑ
Relay pin (brown)
Red wire
Brown wire
Relay pin (red)
White or Yellow wire

Fig. 4-9 Upper drum wiring

3. Unsolder the four wires connecting the lower drum assembly from the relay pins of upper drum assembly (perform quickly to avoid damaging the wires) as shown in Fig. 4-9.
4. Take out two screws Ⓑ and remove the upper drum assembly in the upward direction.
5. Use alcohol to clean the lower face of the new upper drum assembly and the upper face of the lower drum assembly. When handling and installing the new upper drum, avoid directly touching the video heads and use care not to scratch the drum.
6. Reassemble by reversing the above steps. When resoldering, observe the correct channels (brown: CH-1, red: CH-2) and avoid overheating the wires. Use screw Ⓐ to secure the brush assembly together with the earth wire to the video head board. Check that the brush assembly is positioned at the center of the commutator.
7. Perform the following checks and adjustments
   1) Video head switching position (see section 5.4.7).
   2) Tracking preset (see section 5.4.8).
   3) Overall checks and adjustment of the signal systems (see section 5.5).
   4) FM noise pulse width (see section 5.4.13).
   5) Control head phase (see section 4.5.8).

4.3.3 Take-up clutch and take-up idler assemblies

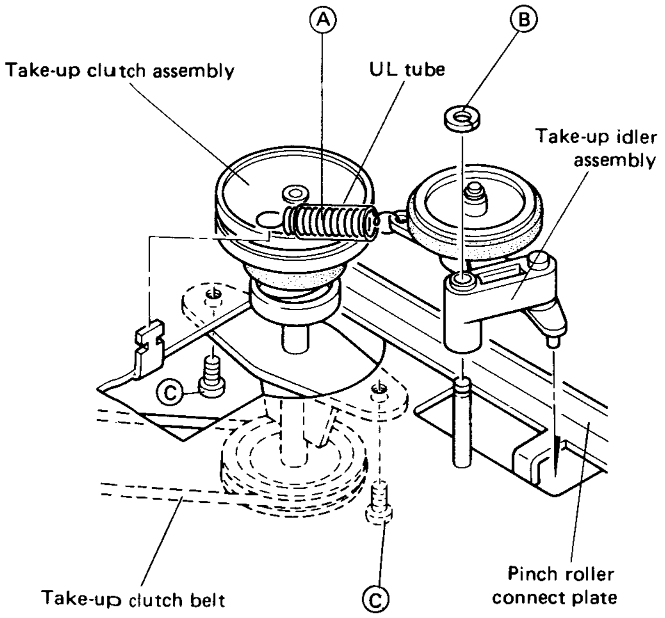


Fig. 4-10 Take-up clutch and take-up idler replacement

1. After unhooking the spring Ⓐ of the take-up idler from the deck, take off the slit washer Ⓑ to remove the take-up idler assembly in the upward direction and replace the take-up idler assembly.
2. From the bottom side, disengage the take-up clutch belt from the pulley of the take-up clutch assembly.
3. Take out two screws Ⓒ and replace the take-up clutch assembly.
4. Reassemble by reversing the above steps. At this time, clean the take-up clutch belt, take-up clutch and take-up idler.
5. Perform take-up torque check as follows.
6. Set for the Play mode without tape (refer to section 4.1.1-6).
7. Set the torque gauge on the take-up reel disk.

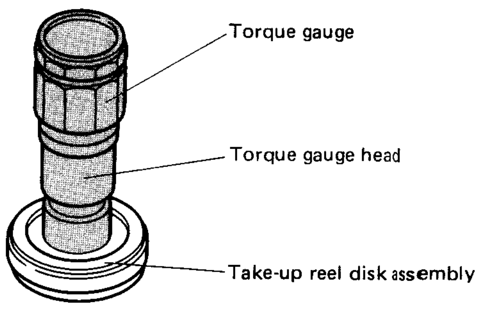


Fig. 4-11 Take up torque check

8. Relax the grip on the torque gauge so that the indicator needle and scale rotate at equal speeds, then read the indication. The correct value is between 60 and 100 gcm.
9. If not the correct value, confirm the conditions of the take-up idler spring and take-up clutch belt.

4.3.4 Reel motor and reel idler assemblies

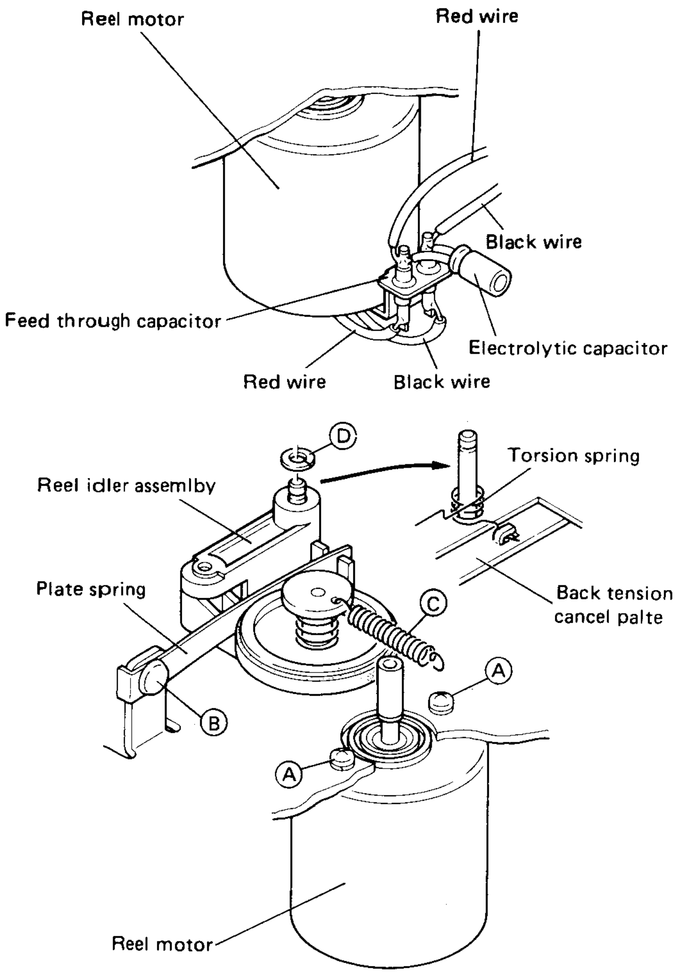

Reel motor
Red wire
Black wire
Feed through capacitor
Electrolytic capacitor
Red wire
Black wire
Ⓓ
Torsion spring
Reel idler assemlby
Plate spring
Ⓒ
Back tension cancel palte
Ⓐ
Ⓑ
Ⓐ
Reel motor

Fig. 4-12 Reel motor and reel idler replacement

1. Unsolder the wires from the feed through capacitor of the reel motor assembly from the bottom side as shown in Fig. 4-12.
2. Take out two screws Ⓐ from the top side and replace the reel motor assembly from the bottom side.
3. After removing the reel motor assembly, take out the plastic rivet Ⓑ and remove the plate spring.
4. After unhooking the spring Ⓒ of the reel idler assembly, take off the slit washer Ⓓ and replace the reel idler assembly.
   Use care regarding the washer and torsion spring when removing the reel idler assembly in the upward direction.
5. Reassemble by reversing the above steps.

4.3.5 Capstan motor assembly

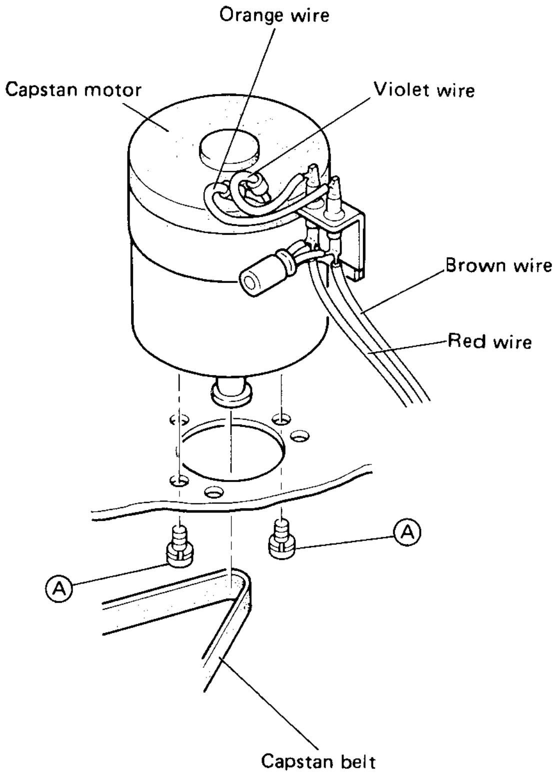

Orange wire
Capstan motor
Violet wire
Brown wire
Red wire
Ⓐ
Ⓐ
Capstan belt

Fig. 4-13 Capstan motor replacement

1. Unsolder the wires from the feed through capacitor as shown in Fig. 4-13.
2. From the bottom side, disengage the capstan belt from the capstan motor pulley.
3. Take out two screws Ⓐ and replace the capstan motor assembly.
4. Reassembly by reversing the above steps.
5. Perform the capstan discri. center check and adjustment (see section 5.4.5).

4.3.6 Loading motor assembly

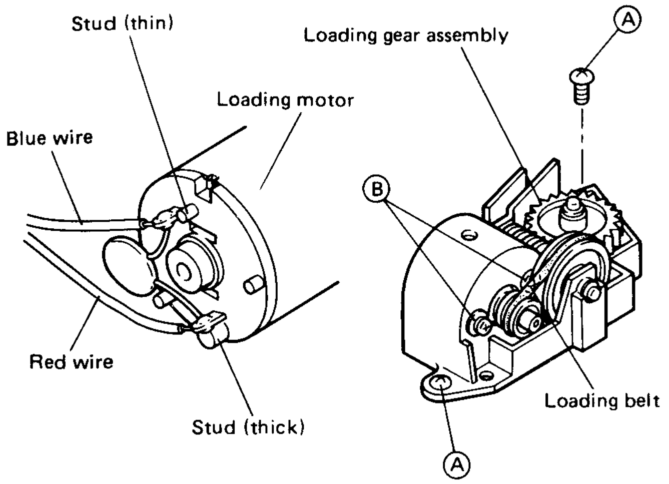

Stud (thin)
Loading gear assembly
Ⓐ
Loading motor
Blue wire
Ⓑ
Red wire
Stud (thick)
Loading belt
Ⓐ

Fig. 4-14 Loading motor replacement

1. Take out two screws Ⓐ and remove the loading gear assembly.
2. Unsolder the motor wires as shown in Fig. 4-14.
3. Disengage the loading belt from the motor pulley; take out two screws Ⓑ and replace the loading motor.
4. Reassembly by reversing the above steps. Turn the loading rings by hand to end of travel (loading end position) and install the loading gear assembly.
5. Turn the loading motor pulley by hand to move the loading ring slightly in the unloading direction. Check for equal spacing between the supply pole guide and supply pole base, and between the take-up pole guide and take-up pole base. If not equal, the loading gear ass'y mounting position is incorrect. Repeat the above step 4.
6. The minus (−) terminal of the loading motor is adjacent to the thicker diameter stud. Solder the wire coming from connector 92 of the junction board to this terminal. Observe that wires do not contact rotating parts.

4.3.7 Audio/Control head assembly

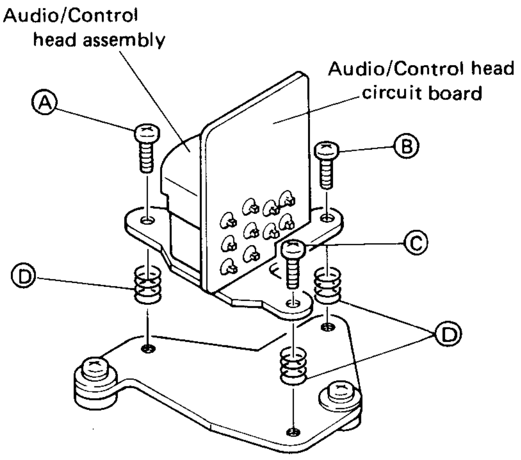

Audio/Control head assembly
Audio/Control head circuit board
Ⓐ
Ⓑ
Ⓒ
Ⓓ
Ⓓ

Fig. 4-15 A/C head replacement

1. Take out three screws Ⓐ , Ⓑ and Ⓒ to remove the A/C head assembly. Use care regarding the coil springs Ⓓ as shown in Fig. 4-15.
2. Unsolder the ten terminals coming from A/C head assembly and remove the A/C head circuit board as shown in Fig. 4-15.
3. Replace the A/C head assembly and reassemble by reversing the above steps.
4. Perform the following checks and adjustments.

A: Tape transport adjustment

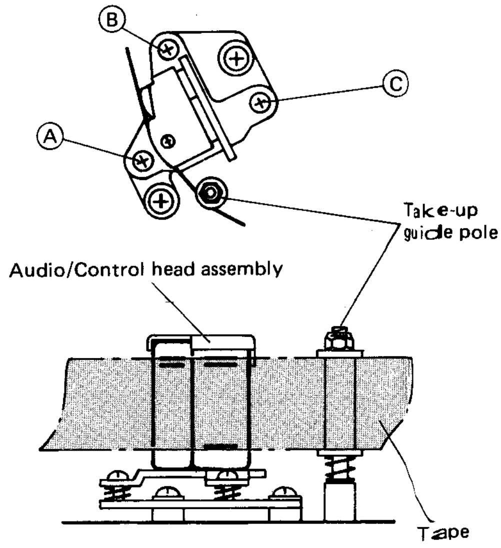

Ⓑ
Ⓒ
Ⓐ
Take-up guide pole
Audio/Control head assembly
Tape

Fig. 4-16 A/C head adjustment

1. Employ a cassette tape and set for Play mode.
2. Turn screw Ⓒ (Fig. 4-16) and adjust for smooth transport at the take-up guide pole. Do not adjust the height of the take-up guide pole itself.

B: Audio/Control head height and azimuth

- Incorrect audio/control head height can impair audio signal-to-noise ratio when playing back a pre-recorded tape.

1. Play alignment tape (6 kHz and stairstep signals) and measure the audio output level.
2. Turn screws Ⓐ, Ⓑ and Ⓒ in succession by small and equal increments at a time and adjust for amximum audio output level. With reference to screw Ⓐ , adjust azimuth with screw Ⓑ and screw Ⓒ so that small tape wrinkles are not produced at the guide pole, but at the same time, audio output becomes maximum and level fluctuations minimum.
   It is suggested to first turn screw Ⓐ by a small amount, then turn screws Ⓑ and Ⓒ by an equal amount and set for maximum output.

C: Final checks and adjustments

1. Perform the interchangeability adjustment (see section 4.5).
2. Perform the audio system adjustment (see section 5.6).

4.3.8 Reel disk, tension band and cue head

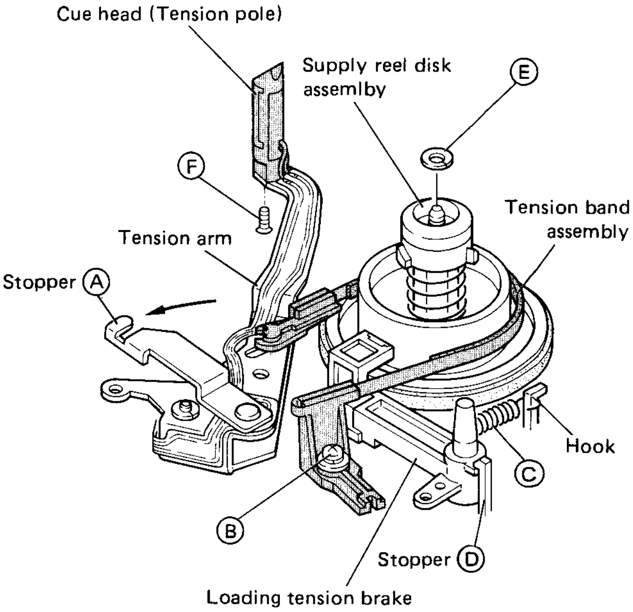


Fig. 4-17 Reel disk and tension band replacement

1. Slide stopper Ⓐ toward the left, then take out screw Ⓑ and remove the tension band assembly.
2. Unhook the spring Ⓒ, bend the stopper Ⓓ and remove the loading tension brake in the upward direction.
3. Take off the slit washer Ⓔ to replace the reel disk assembly. Use care regarding the washers when removing the reel disk assembly in the upward direction.
4. Reassemble by reversing the above steps. Apply a small amount of oil to the reel shaft.
5. To remove the cue head, unsolder the lead wires and take out screw Ⓕ. When replacing, use care regarding the mounting angle.
6. Perform the following checks and adjustments.

A: Reel disk height

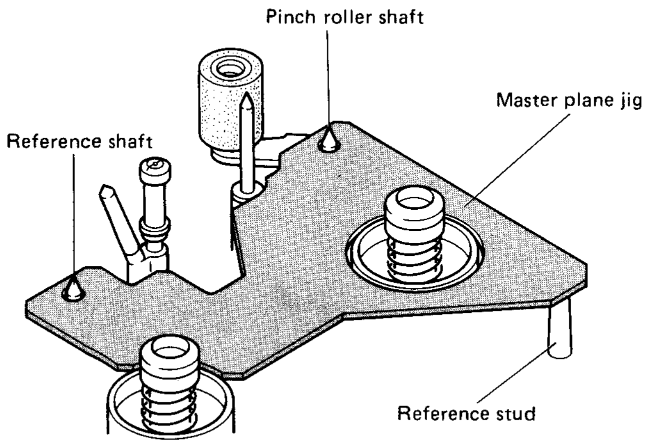

Pinch roller shaft
Master plane jig
Reference shaft
Reference stud

Fig. 4-18 Master plane jig setting

1. Set the master plane jig as shown in Fig. 4-18.

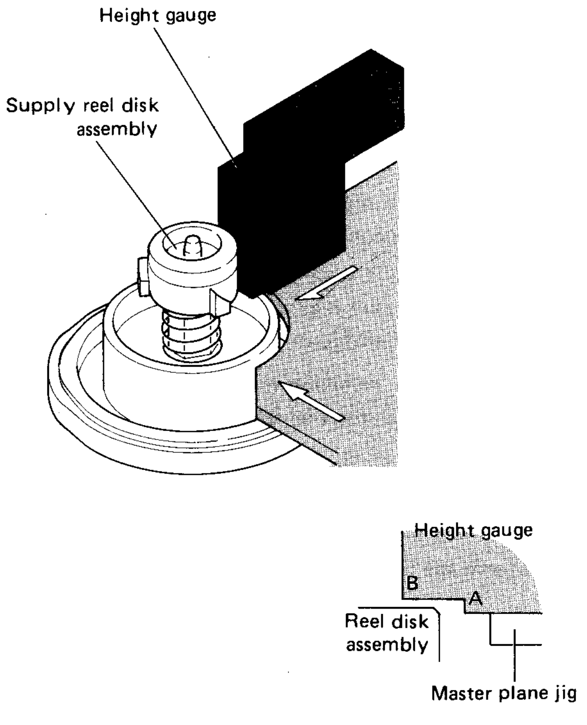

Height gauge
Supply reel disk assembly
Height gauge
B
A
Reel disk assembly
Master plane jig

Fig. 4-19 Reel disk height adjustment

2. Use the height gauge to check the reel disk assembly height. Measure at two places 90° apart.
3. The correct height is between planes A and B as shown in Fig. 4-19.

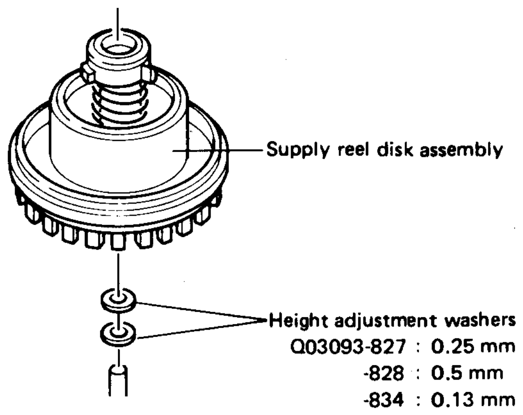

Supply reel disk assembly
Height adjustment washers
Q03093-827 : 0.25 mm
-828 : 0.5 mm
-834 : 0.13 mm

Fig. 4-20 Washers for height adjustment

4. If it is necessary to adjust the height, add or subtract the required number of height adjustment washers as shown in Fig. 4-20.
5. After reassembling, confirm a small amount of mechanical play between reel disk and slit washer.
6. Height adjustment is not required for the take-up reel disk.

B: Cue head mounting angle

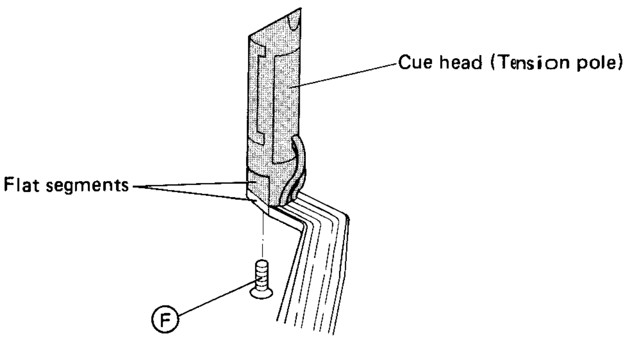

Cue head (Tension pole)
Flat segments
Ⓕ

Fig. 4-21 Cue head mounting angle

1. Mount the cue head using screw Ⓕ, but do not tighten fully.
2. As shown in Fig. 4-21, align the flat segments of the cue head and tension arm, then tighten screw Ⓕ.

C: Tension pole (cue head) position

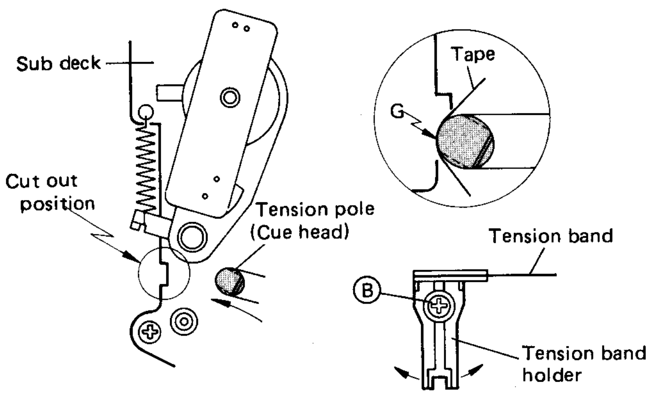

Sub deck
Cut out position
Tension pole (Cue head)
Tape
G
Tension band
Ⓑ
Tension band holder

Fig. 4-22 Tension pole (cue head) position adjustment

1. While the tape is running, check that point G of the cue head (tension pole) is positioned within the 0.5 mm range shown in Fig. 4-22.
2. If necessary, loosen screw Ⓑ and adjust the tension band holder to obtain the correct tension pole position.

   Note: If back tension is incorrect, check the tension pole position. Use the back tension cassette gauge and confirm a value of between 30 g to 40 g. If necessary, replace the back tension arm spring and re-adjust the tension pole position.

4.3.9 Pinch roller solenoid

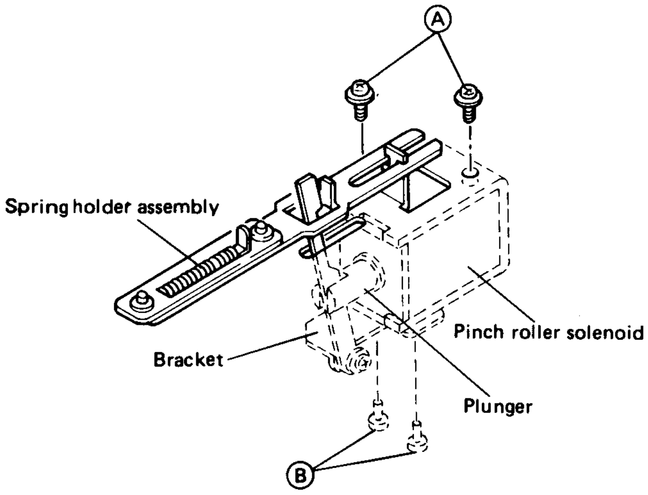

Ⓐ
Spring holder assembly
Bracket
Pinch roller solenoid
Plunger
Ⓑ

Fig. 4-23 Pinch roller solenoid replacement

1. Take out two screws Ⓐ and remove the pinch roller solenoid.
2. Take out two screws Ⓑ, remove the solenoid bracket and replace the pinch roller solenoid (ordinarily, it is not necessary to replace the plunger).
3. Reassemble by reversing the above steps, but do not tighten screws Ⓐ firmly at this time.
4. Without tape, supply power and set for the Play mode.

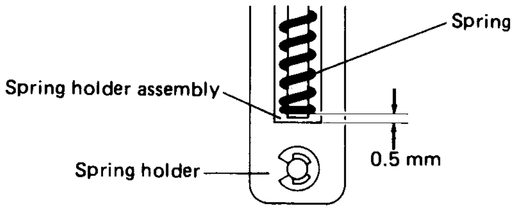

Spring
Spring holder assembly
Spring holder
0.5 mm

Fig. 4-24 Pinch roller solenoid adjustment

5. Adjust the solenoid mounting position for 0.5 mm space between the spring holder and spring as shown in Fig. 4-24. Then tighten the screws Ⓐ firmly. This step adjusts pinch roller pressure.

4.3.10 Capstan flywheel and capstan FG board

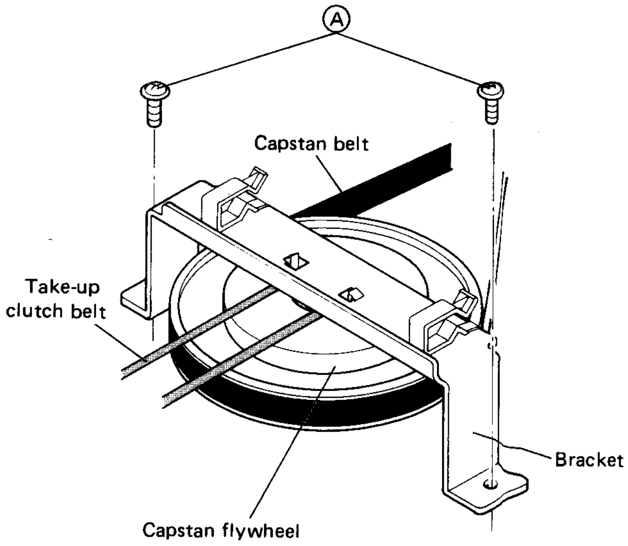

Ⓐ
Capstan belt
Take-up clutch belt
Bracket
Capstan flywheel

Fig. 4-25 Capstan flywheel replacement

1. Take out two screws Ⓐ and remove the bracket. See Fig. 4-25.
2. Disengage the take-up clutch and capstan belts, then gently remove the capstan flywheel in the upward direction. At this time, use care not to misplace the capstan oil seal and spacer attached to the capstan.

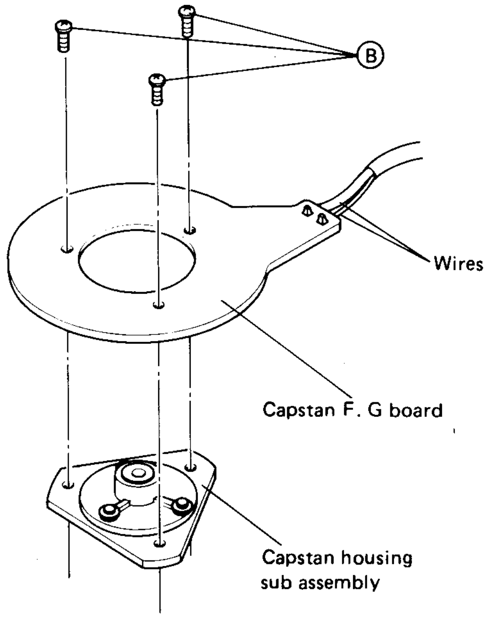


Fig. 4-26 Capstan F.G. board replacement

3. Take out three screws Ⓑ, indicated in Fig. 4-26, and remove the capstan FG board. Unsolder the lead wires.
4. Reassemble by reversing the above steps. After mounting the capstan flywheel, spacer and capstan oil seal, use alcohol to thoroughly clean the capstan.

4.4 TAPE TRANSPORT SYSTEM CHECKS AND ADJUSTMENT

The tape transport system has been precisely aligned at the factory and normally does not require readjustment. The following steps are therefore necessary only in cases of severe usage or when replacing parts affecting the tape transport system.

4.4.1 Tape transport check

1. Employ a 120-minute tape and check at tape beginning and ending portion according to the following steps.
2. Operate the machine between Play and Stop modes several times.
   During Loading and Unloading, observe the tape at the supply and take-up guide rollers and guide poles.
   Confirm absence of curling, wrinkling, etc. as shown in Fig. 4-27.

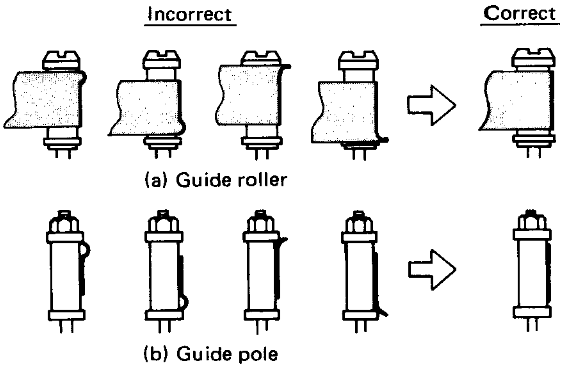


Fig. 4-27 Guide roller and guide pole

3. Observe the tape as it becomes wrapped around drum during loading and as it separates from the drum during unloading.

   Confirm absence of damage to the tape at points Ⓐ and Ⓑ as shown in Fig. 4-28 and absence of contact noise between head tips and tape edge.

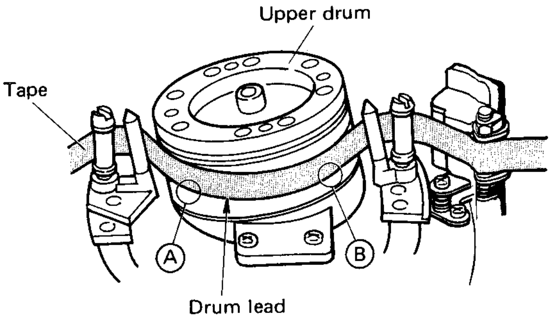


Fig. 4-28 Drum lead check-1

NOTES:

1. Slips upward : sound becomes produced by contact between tips of rotating heads and edge of tape.
2. Slips downward : tape curls or wrinkles from contacting lead face (sound may also be produced).

4. During Play mode, observe tape at the input and output portions (Ⓒ and Ⓓ in Fig. 4-29) of the head drum lead.
   Confirm that the tape slips neither upward nor downward with respect to the lead as shown in Fig. 4-30.

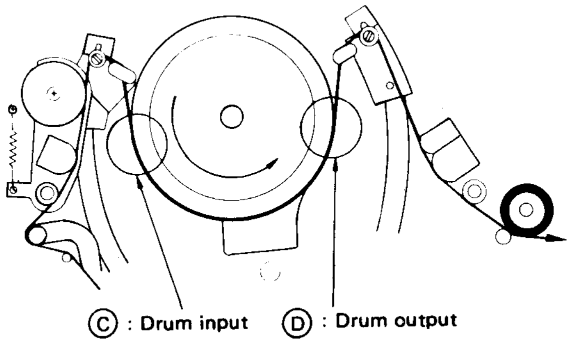


Fig. 4-29 Tape transport check

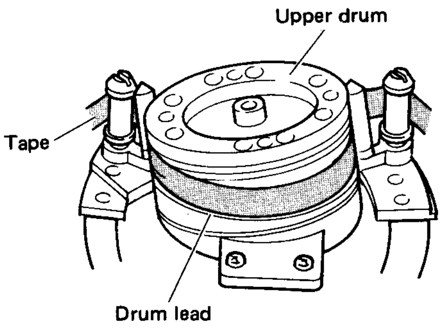


Fig. 4-30 Drum lead check - 2

5. During Play mode, observe the tape at the take-up and supply guide poles and guide rollers.
   Confirm absence of curling, wrinkling, etc. as shown in Fig. 4-27.
6. If defects are noted the above checks, perform the following adjustments.

4.4.2 Tope transport adjustments

Perform only if defects are noted during tape transport check (4.4.1).

A: Guide roller height adjustment

1. Slightly loosen setscrews of the supply and take-up guide rollers as shown in Fig. 4-31.
2. Use a cassette tape and set for Play mode.
3. With a slotted screwdriver, slightly turn the supply guide roller (do not turn more than 180° at a time) and adjust so that at the drum input, the tape travels smoothly in the drum lead without slipping upwards or downwards.
4. Similarly, adjust the take-up guide roller for the drum output.

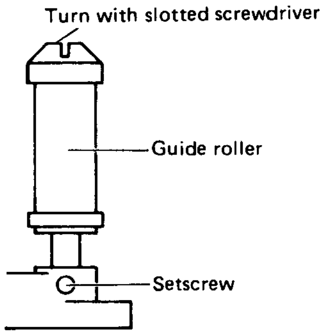


Fig. 4-31 Guide roller height adjustment

NOTES:

1. Loosen the setscrews only enough to allow the guide rollers to be turned.
   If excessively loose, tape motion may turn the rollers inadvertently.
2. Turn the rollers carefully to avoid damage to the tape.

B: Guide pole height adjustment

(a) Guide pole height check

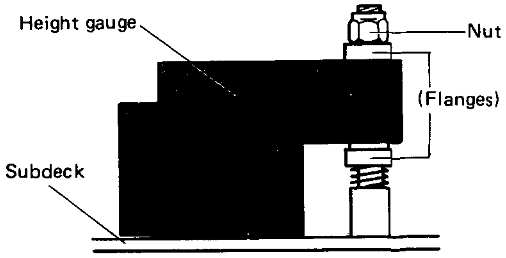


Fig. 4-32 Guide pole height adjustment

1. Set the height gauge on the subdeck as shown in Fig. 4-32.
2. For each guide pole, check the height of the lower face of the upper flange. If necessary, carefully adjust by turning the nut.
   After adjusting the height using the height gauge, turn the supply side nut 50° counter-clockwise and the take-up side nut 90° clockwise. This will provide the required slight difference in height between the supply and take-up guide poles.
3. If guide pole height has been adjusted, following checks and adjustments are required.

(b) Supply guide pole height adjustment

1. Use a cassette tape and set for Play mode.
2. Use a metric nutdriver to turn the supply guide pole to align the upper flange of the guide pole with the upper edge of the tape as shown by (b) of Fig. 4-27. However, this adjustment must be performed so that at the same time, the upper flange remains within ±0.5 mm of the height adjusting jig portion shown in Fig. 4-32.

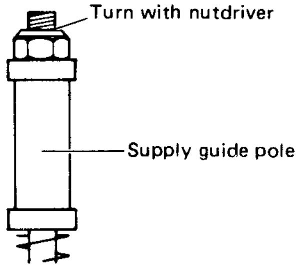


Fig. 4-33 Supply guide pole height adjustment

3. If there is a large discrepancy, check the height of the supply reel disk, tension pole and other mechanical components.

C: Audio/Control head adjustment

1. Employ a cassette tape and set for Play mode.
2. Turn audio/control head screw ⓒ as shown in Fig. 4-34 and adjust for smooth transport at the take-up guide pole as shown by (b) of Fig. 4-27.

NOTE: Do not adjust the height of the take-up guide pole itself.

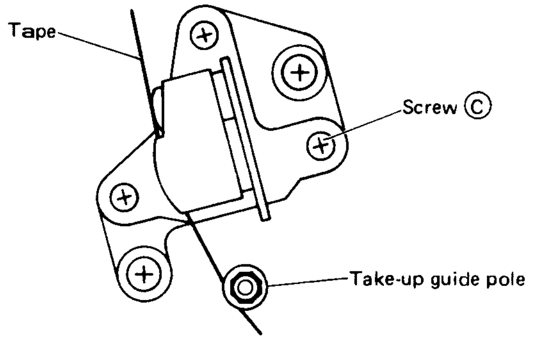


Fig. 4-34 Take-up guide pole

4.5 INTERCHANGEABILITY ADJUSTMENT

Before using alignment tape, employ a tape and confirm correct tape transport.

4.5.1 Preliminary checks

A: Check sequence 1

1. Connect oscilloscope to TP-106 of the Y & PRE/REC board. At this time, trigger the oscilloscope externally with the signal from TP-111 (DRUM F.F in) of the Y & PRE/REC board.
2. Play Stairstep portion of the alignment tape MH-2.
3. Turn the Tracking control and adjust for maximum FM output at TP-106.
   Set the Tracking control to AUTO (center click position) and confirm that nearly maximum output is obtained.

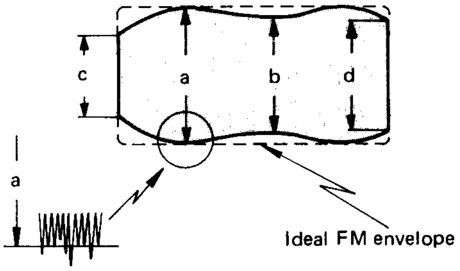


Fig. 4-35 FM waveform (max. output)

4. Refer to Fig. 4-35. Read the level of portion (a) of the waveform. If the waveform is serrated at point (a), read the value at the most uniform serrations as shown at left in Fig. 4-35.
5. Read the maximum FM level (a) and minimum FM level (b), and confirm that:

$$\frac{b}{a} \geqq 0.7 \text{ or } 20\log\frac{b}{a} \geqq -3\text{ dB}$$

6. Read the values at points (c) and (d) [drum input and output] and confirm that:

$$\frac{c}{a} \geqq 0.5 \text{ and} \frac{d}{a} \geqq 0.5 \; (\geqq -6\text{ dB})$$

NOTES:

1. Read minimum levels for (b), (c) and (d).
2. If above checks yield normal results, proceed to section 4.5.1 - B.
3. If defects are noted, perform adjustments of section 4.5.2.

B: Check sequence 2

1. Observe the FM waveform as in the previous section (4.5.1 - A) and turn the Tracking control.
   The waveform variation should be nearly parallel as shown in Fig. 4-36.

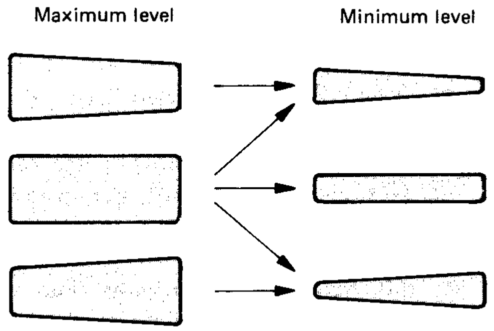


Fig. 4-36 Normal waveform examples

2. If the waveform varies as shown in Fig. 4-37, adjustment becomes required.

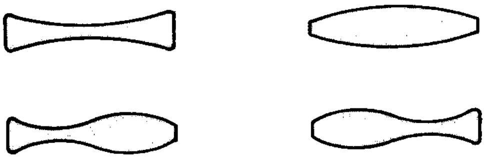


Fig. 4-37 Incorrect waveform examples

4.5.2 Preliminary adjustments

1. Loosen the setscrews of the supply guide roller and take-up guide roller.
   If the guide rollers turn freely, slightly tighten the setscrews.
2. Connect oscilloscope to TP-106 of the Y & PRE/REC board. Trigger the oscilloscope externally with the signal from TP-111 (DRUM F.F in) of the Y & PRE/REC board.
3. Play the alignment tape (stairstep signal) MH-2.

A: Drum input

1. Observe oscilloscope display and adjust the Tracking control for maximum FM output.
2. Refer to Fie. 4-38. Examples of incorrect waveforms are shown by A.
   Use a slotted screwdriver to adjust the supply guide roller so that the rising portion (drum input portion) of the waveform becomes flat as shown by B.

   NOTES:
   1. If the guide roller turns freely, tighten the setscrew slightly.
   2. Be sure to adjust the guide roller only by small amounts at a time in order to avoid damaging the alignment tape.

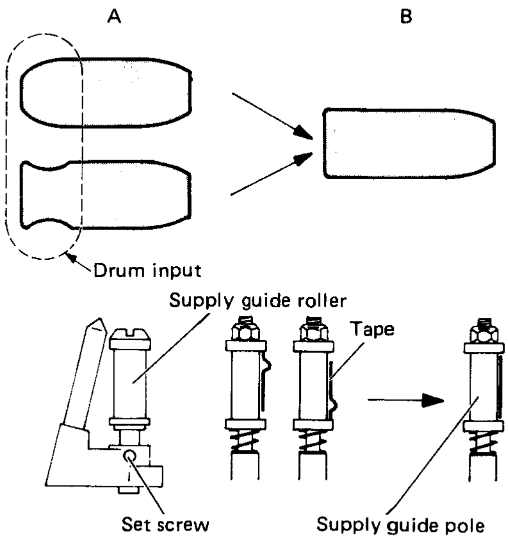


Fig. 4-38 Drum input adjustment

   In addition to observing the waveform, confirr absence of tape slippage or curling at the drum lea and guide poles.
3. At the supply guide pole, if the tape separates fror the guide or wrinkling occurs, adjust the guide pol height.

B: Drum output

1. In the same manner as for the drum input, turn the take up guide roller to adjust the falling portion (drum out put portion) of the FM waveform.
   Incorrect examples are shown by Ⓒ in Fig. 4-39, whil Ⓓ indicates the correct adjustment.
2. If the tape separates from the guide or wrinkling occur at the take-up guide pole, adjust by turning screw Ⓒ o the audio/control head as shown in Fig. 4-39.

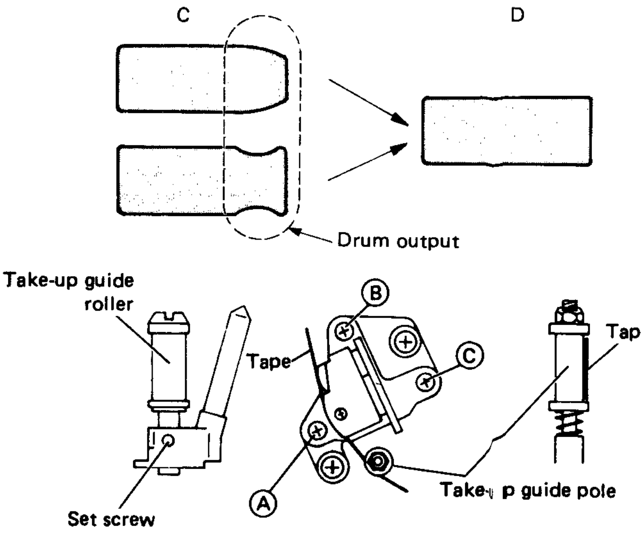


Fig. 4-39 Drum output adjustment

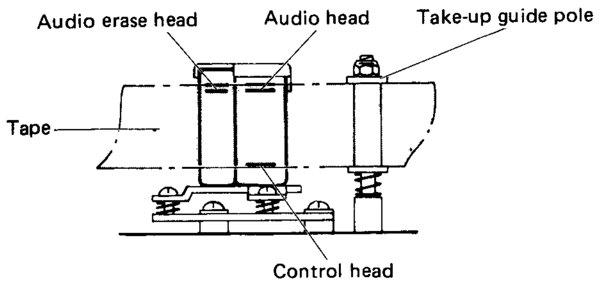


Fig. 4-40 Audio/Control head height

3. Carefully and evenly adjust screws Ⓐ, Ⓑ and Ⓒ to align the audio/control head height with the tape as shown in Fig. 4-40.

NOTES:

1. Fine adjustment is not required at this time. It is sufficient that the tape is engaged with the guide pole and servo operates stably (control signal picked up).
2. If the tape separates from the take-up guide pole or wrinkling occurs, screw Ⓒ (Fig. 4-39) has been turned excessively with respect to screws Ⓐ and Ⓑ, causing the audio/control head to incline forward or rearward. Use care to adjust screws Ⓐ, Ⓑ and Ⓒ evenly and observe that small wrinkles are not produced at the take-up guide pole.
3. Do not disturb the take-up guide pole.

4.5.3 Interchangeability fine adjustment

1. Connect oscilloscope to TP-106 of the Y & PRE/REC board. Play stairstep segment of the alignment tape MH-2. Observe the FM waveform and adjust the Tracking control for minimum FM output level.

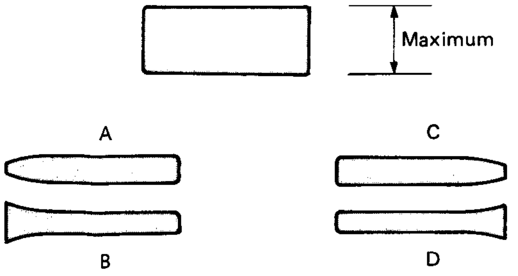


Fig. 4-41 Minimum FM output (incorrect examples)

2. If the waveform becomes as shown by A or B of Fig. 4-41, carefully adjust the supply guide roller height so that the waveform becomes as shown by E, F or G of Fig. 4-42.
   At this time, if the waveform fluctuates, adjust to the point of minimum fluctuation.

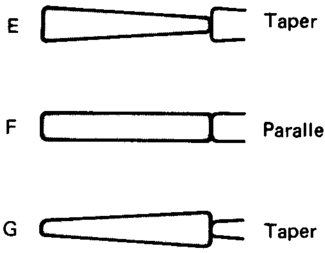


Fig. 4-42 Minimum FM output (correct examples)

3. If the FM waveform appears as shown by C or D in Fig. 4-41. carefully adjust the take-up guide roller height to obtain a waveform such as shown by E, F or G of Fig. 4-42.
   At this time, if the waveform fluctuates, adjust to the point minimum fluctuation.
4. Vary the Tracking control from maximum to minimum FM output.
   Perform fine adjustment of supply and take-up guide rollers so that waveform variation becomes as shown by E, F or G of Fig. 4-42.

4.5.4 Audio/Control head height, azimuth and inclination

See section 4.3.7-B Audio/Control head height and azimuth.

4.5.5 Setscrew tightening

1. Check for maximum FM output waveform, maximum audio out and absence of tape wrinkling or other transport irregularities, then secure the guide rollers.
   Perform in Stop mode.
2. Since the guide rollers are easily moved, use care when securing.
3. After tightening the setscrews, again perform interchangeability final check.

4.5.6 Interchangeability final check

Confirm section 4.5.1 Preliminary checks.

4.5.7 Servo circuit adjustment

1. Video head switching position (see section 5.4.7).
2. Tracking preset (see section 5.4.8).

4.5.8 Control head phase adjustment

1. Connect oscilloscope to TP-106 of the Y & PRE/REC board. Trigger the oscilloscope externally with the signal from TP-111 (DRUM F.F in) of the Y & PRE/REC board.
2. Play stairstep portion of the alignment tape MH-2 and observe the oscilloscope display.
3. Set the Tracking control to AUTO (center click position).

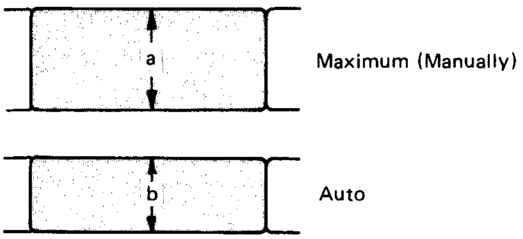


Fig. 4-43 FM output level

4. Confirm that the level difference between this setting and the maximum level obtained manually is:

$$-20 \log \frac{b}{a} \leqq 1 \text{ dB or } \frac{b}{a} \geqq 0.9$$

5. If necessary, adjust as follows.
6. Set the Tracking control to AUTO and play stairstep segment of the alignment tape MH-2.
7. Loosen two screws Ⓓ and Ⓔ and slide the A/C head assembly fully in the direction to the take-up guide pole.

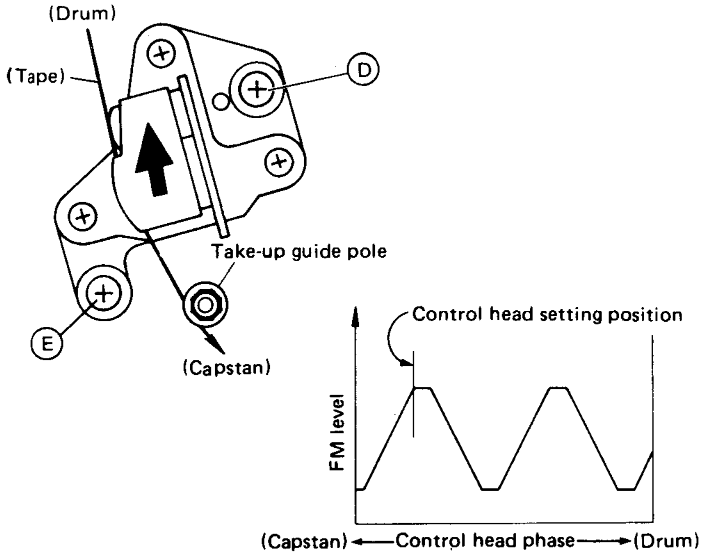

(Drum)
(Tape)
D
Take-up guide pole
E
(Capstan)
Control head setting position
FM level
(Capstan)←Control head phase→(Drum)

Fig. 4-44 Control head phase adjustment

8. Slightly tighten the two screws and play stairstep segment of the alignment tape MH-2.
9. Set the audio/control head position tool (PUJ47351-2) over the screw Ⓓ and insert the pin of the tool into the hole at the side of the screw.
10. Slowly turn the tool and slide the A/C head assembly in the direction of the arrow as shown in Fig. 4-44.
11. Set the A/C head assembly to the position where first maximum FM level is obtained. Tighten two screws Ⓓ and Ⓔ.

4.5.9 Final checks (recording and playback)

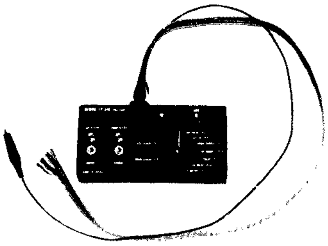
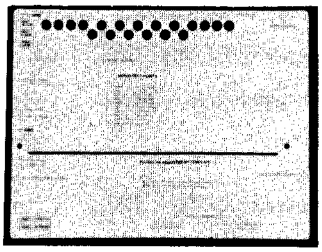
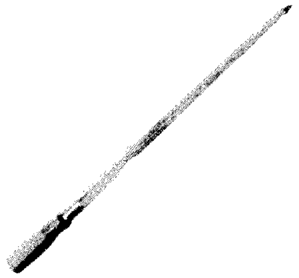
1. Use a blank tape and perform recording and playback. Confirm FM waveform and specifications equivalent to those during playback of alignment tape (stairstep signal). See section 4.5.1.
2. Perform checks and adjustments of the audio recording and playback levels. See section 5.6 Audio circuit.
3. Check other signal systems by referring to section 5 electronic adjustment.

SECTION 5
ELECTRICAL ADJUSTMENTS

5.1 PREPARATION

Electrical adjustments are required after replacing circuit components and certain mechanical parts. It is important to perform these adjustments only after all repairs and replacements have been completed. Also, do not attempt these adjustments unless the proper equipment is available.

Required test equipment and jigs
- Digital voltmeter : High sensitivity
- Oscilloscope : Wide-band, Dual-trace
- Signal generator : PAL-color bar and stairstep, SECAM-color bar NTSC-color bar
- Frequency counter : High sensitivity, High impedanc
- Regulated DC power supply : 0 – 30 V
- Audio generator
- TV signal generator : With color bar and stairstep signal outputs

• JVC Alignment Tape MH-2 (PAL) and MH-5 (NTSC /SECAM) 	• Servo TP jig PUJ43067 	• Adjustment Template PUJ36331G 	• Long shafted driver PUJ43620 

NOTES: Be sure to check for smooth and proper tape transport before using the alignment tape.

IMPORTANT:
Even with the Sub-power switch off, DC voltage is supplied to the circuits. Therefore, set the rea panel MAINS POWER switch to off before performing service or replacing parts.

5.2 REGULATOR CIRCUIT

Unless otherwise indicated, all test points and adjustments are located on the REGULATOR board.

5.2.1 Regulated all 12V DC

1. Connect a digital voltmeter to TP2 (ALL 12V OUT) and set for the STOP (E-E) mode.
2. Adjust R15 (12V ADJ) for 12.0 ± 0.1 V DC.

5.2.2 Regulated 12V DC for CAMERA connector

1. Set the REC SELECT switch to CAMERA mode.
2. Connect a digital voltmeter to CONN. 32 (12V OUT) and set for the STOP (E-E) mode.
3. Confirm that the DC voltage is 13.0 ± 1.0 V.

5.2.3 Drum 12V DC

1. Connect a digital voltmeter to CONN. 84 (DRUM 12V OUT) and set for the STOP (E-E) mode.
2. Confirm that the DC voltage is 13.0 ± 1.0V.

5.2.4 Unregulated 22V DC

1. Connect a digital voltmeter to TP3 (UNREG 22V OUT and set for the STOP (E-E) mode.
2. Confirm that the DC voltage is 23.0 ± 3.0V.

5.2.5 Switched 12V DC

1. Connect a digital voltmeter to CONN. 83 (SW 12V OUT) and set for the STOP (E-E) mode.
2. Confirm that the DC voltage is 12.0 ± 0.2 V.

5.3 TUNER/TIMER SUB CIRCUIT

Unless otherwise indicated, all test points and adjustments are located on the T/T (Tuner/Timer) SUB board.

Set for the STOP (E-E) mode.

5.3.1 3V AC

1. Connect a digital voltmeter between CONN. 122 and 123.
2. Confirm that the AC voltage is 3.0 ± 0.3 V.

5.3.2 –24V DC

1. Connect a digital voltmeter to CONN. 124.
2. Confirm that the DC voltage is –24 ± 1 V.

5.3.3 44V AC

1. Connect a digital voltmeter to CONN. 125.
2. Confirm that the AC voltage is 44 ± 6 V.

5.3.4 Back-up 5 V

1. Connect a digital voltmeter to CONN. 126.
2. Confirm that the DC voltage is 5.1 ± 0.4V.

5.3.5 30V REG.

1. Connect a digital voltmeter to CONN. 127.
2. Adjust R298 (30V REG ADJ) for 30.6 ± 0.1V DC.

5.4 SERVO CIRCUIT

NOTES:

1. Use the SERVO TP JIG for checkes and adjustments of the servo circuit.
2. Servo circuit test points we mainly formed by the 10 pin socket on the upper surface of the set (near the upper drum). Therefore connect the 10 pin plug of the SERVO TP JIG to this socket and the earth plug of the jig to the sub chassis earth terminal as indicated in Fig. 5-1.
3. Be sure to set the rear panel MAINS POWER switch to OFF before connecting the SERVO TP JIG.
4. Adjustments are performed by inserting an insulated alignment tool into the guide tubes located on the chassis.
5. Where not otherwise noted, test points and variable resistors are located on the SERVO board.

IMPORTANT:

Check that the Sub-power switch is on before measuring voltages at IC3 and IC12. These devices can be damaged if measurement is performed with power off.

5.4.1 Preparation

A. SERVO TP JIG

1. Engage the 10 pin plug of the jig with the 10 pin socket of the set. Connect the earth plug of the jig to the sub chassis earth terminal as indicated in Fig. 5-1.
2. Connect the oscilloscope probe to the TP and GND terminals of the jig. By using the selector switch, 9 waveforms can be observed.
3. When not otherwise noted, set the CAP. DISCRI and DRUM DISCRI switches to the NORMAL positions.
4. With either the CAP. DISCRI or DRUM DISCRI switch in the NORMAL position, LED lighting according to mode becomes as shown in Table 5-1.

MODE	LED States	
	CAP DISCRI	DRUM DISCRI
Stop (E-E)	Lights	Lights dimly
Play or REC (Loading complete)	Extinguishes	Extinguishes
Search REW or FF	Lights	Lights dimly
Discriminator mode	Lights	Lights

Table 5-1 LED Lighting

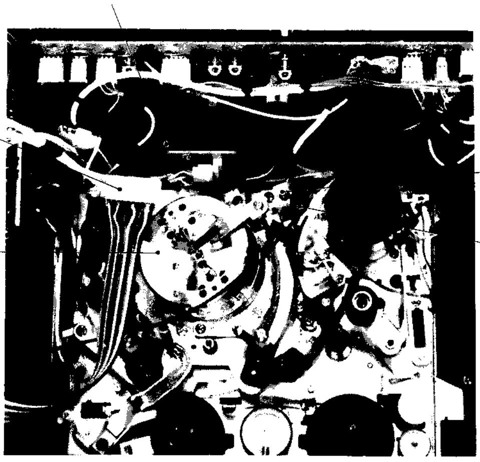


Fig. 5-1 Servo test poins and tool guide tubes

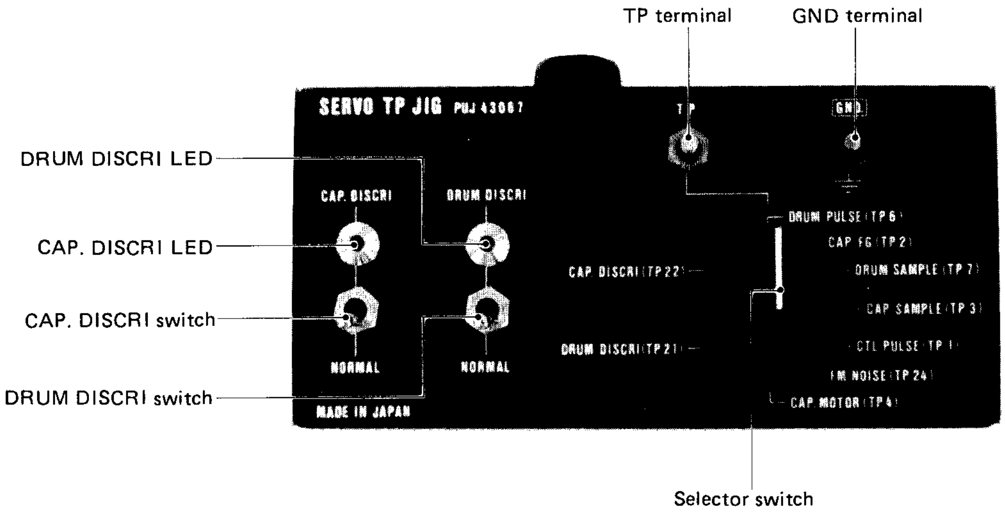

TP terminal
GND terminal
SERVO TP JIG PUJ 43087
T P
GND
DRUM DISCRI LED
CAP. DISCRI LED
CAP. DISCRI switch
DRUM DISCRI switch
CAP. DISCRI
DRUM DISCRI
NORMAL
NORMAL
MADE IN JAPAN
CAP. DISCRI (TP 22)
DRUM DISCRI (TP 21)
DRUM PULSE (TP 6)
CAP FG (TP 2)
DRUM SAMPLE (TP 7)
CAP SAMPLE (TP 3)
CTL PULSE (TP 1)
FM NOISE (TP 24)
CAP MOTOR (TP 4)
Selector switch

Fig. 5-2 SERVO TP JIG

B: Adjustment Template

1. The adjustment template is available for convenience in identifying the variable resistors when adjusting the Servo board.
2. The template is used for the top side of the set.
3. Use 2 screws Ⓐ of the cassette housing to hold the template in place as shown in Fig. 5-3.
4. When adjusting the Servo circuit, employ a long shafted screwdriver. Insert it into the appropriate guide tube and carefully turn the control.

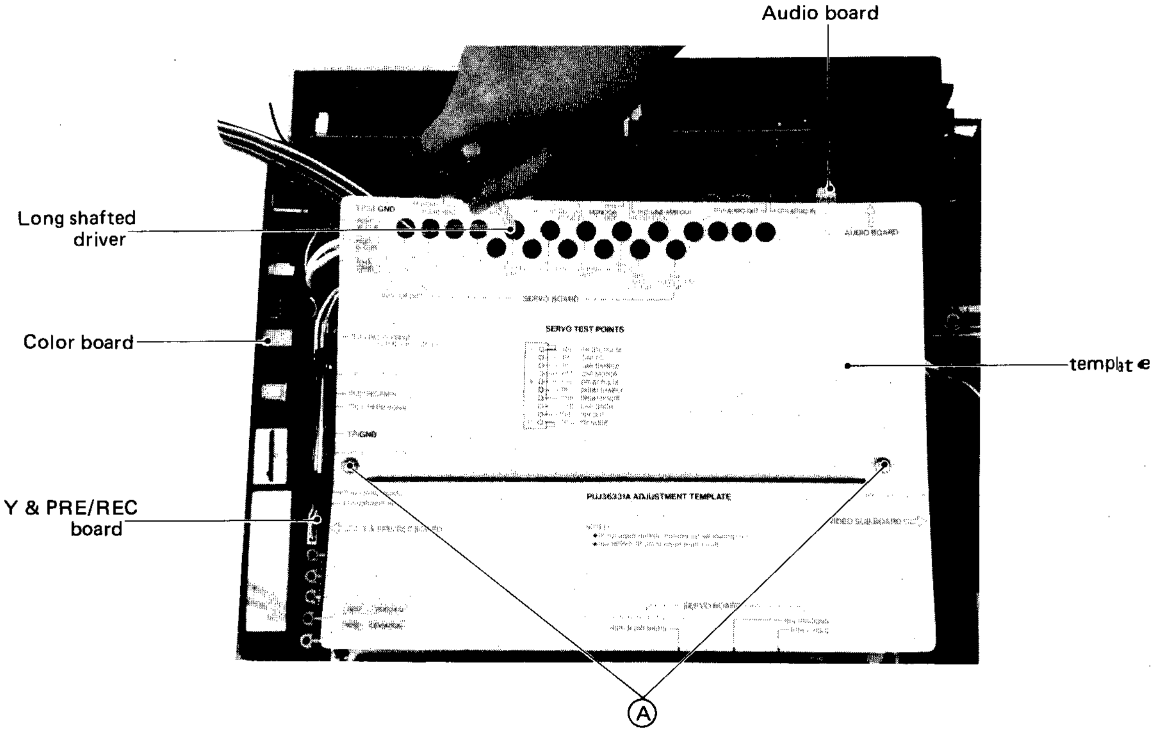

Audio board
Long shafted driver
Color board
Y & PRE/REC board
template
Ⓐ
SERVO TEST POINTS
PUJ36331A ADJUSTMENT TEMPLATE

Fig. 5-3 Adjustment template

5.4.2 Drum pulse level

1. Play color bar segment of JVC MH-2 alignment tape.
2. Set the selector switch of the jig to DRUM PULSE (TP-6) position.
3. Adjust R56 that (a) and (b) become 0.75 ± 0.2 V.

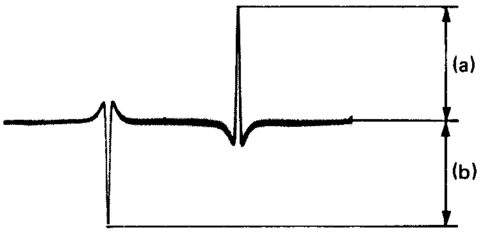


Fig. 5-4 Drum pick up pulse

5.4.3 Drum discriminator center

1. Supply a NTSC color bar signal and set for the recording mode.
2. Set the selector switch of the jig to DRUM SAMPLE (TP-7) and the DRUM DISCRI switch to ON (DRUM DISCRI LED lights).
3. Adjust R102 to stabilize the sampling pulse with respect to the trapezoid. At this time, a slow drift toward the left at the rate of less than 40 msec in 5 seconds is acceptable.
4. Set the jig DRUM DISCRI switch to NORMAL and confirm a stable sampling pulse positioned at the center of the ramp.
5. Supply a PAL color bar signal and set the recording mode.
6. Perform the step 2.
7. Adjust R100 to stabilize the sampling pulse with respect to the trapezoid. At this time a slow drift toward the left at the rate of less than 33 msec in 5 seconds is acceptable.
8. Perform the step 4.

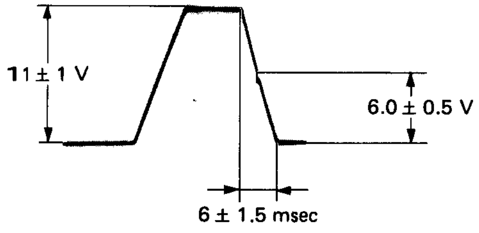
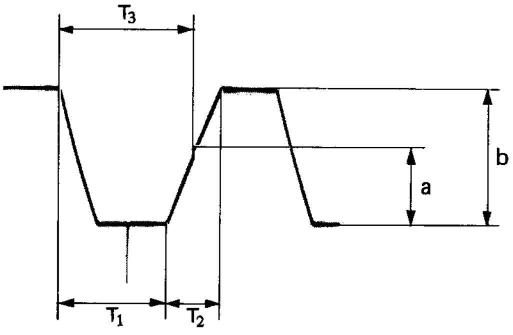


Fig. 5-5 Drum sampling

5.4.4 Capstan discriminator center

1. Supply a PAL color bar signal and set for the recording mode.
2. Set the jig selecter switch to CAP. SAMPLE (TP-3) and the CAP. DISCRI switch to ON (CAP. DISCRI LED lights).
3. Adjust R14 to stabilize the sampling pulse with respect to the trapezoid. At this time, a slow leftward drift at the rate of less than 40 msec in 5 seconds is acceptable.
4. Set the jig CAP. DISCRI switch to NORMAL and confirm a stable sampling pulse positionded at the center of the ramp (T_3 = 24 ± 1.5 msec).
5. Supply a NTSC color bar signal and set for the recording mode.
6. Perform the step 2.
7. Adjust R12 to stabilize the sampling pulse with respect to the trapezoid. At this time, a slow leftward drift at the rate of less than 33 msec in 5 seconds is acceptable.
8. Perform the step 4.



PAL
a = 6 ± 0.5 V
b = 11 ± 1 V
T_1= 20 ± 1.5 msec
T_2= 9.5 ± 1.5 msec

NTSC
a = 6 ± 0.5 V
b = 11 ± 1 V
T_1= 16.7 ± 1.5 msec
T_2= 9.5 ± 1.5 msec

Fig. 5-6 Capstan sampling

5.4.5 Video head switching position

A: Playback switching position

1. Play stairstep segment of JVC MH-2 alignment tape and set the tracking VR to center clik position.
2. Trigger the oscilloscope externally with the signal form TP-111 (DRUM F.FLOP) on the Y & PRE/REC board and set the oscilloscope sync slope to minus (–).
3. Connect the oscilloscope to TP-1 (VIDEO OUT) of the REAR CONNECTOR board and adjust R61 so that the fall portion of the vertical sync signal becomes positioned 6.5 H of the trigger (switching) point as shown in Fig. 5-7.

4. Set oscilloscope sync slope to pulse (+). In this condition, adjust R58 to obtain 6.5 H position.

B: Recording switching position

5. Supply a PAL color bar signal and set for the recoding mode.
6. In same manner as above step 2, 3 adjust R73 to obtain 6.5 H position at TP-1 (VIDEO OUT) of the REAR CONNECTOR board.

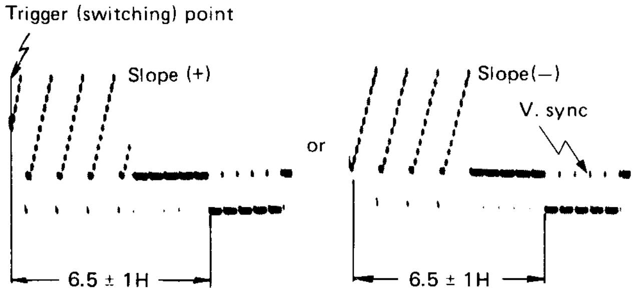


Fig. 5-7 Head switching position

5.4.6 Tracking preset

1. Supply a PAL color bar signal, record, then playback in the double-speed (X2) mode.
2. Set the tracking VR to AUTO (center clik position).
3. Adjust R40 to obtain the best picture on the TV monitor.
4. Supply a NTSC color bar signal, record then playback.
5. Set the jig selector switch to CTL. PULSE (TP-1).
6. Connect the second probe of the oscilloscope to TP-111 (DRUM F.F.) fo the Y & PRE/REC board. Observe the two waveforms at the same time and adjust R42 for T = 0.5 ± 1 msec in the Fig. 5-8.

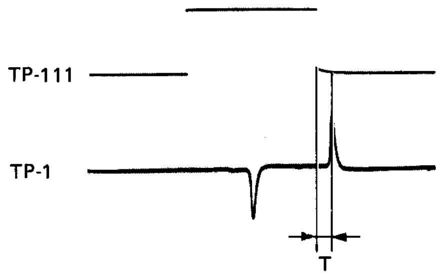


Fig. 5-8 Tracking preset

5.4.7 Slow pulse width

1. Supply a NTSC color bar signal, record, then playback in slow mode.
2. Set the jig selector switch to CAP. MOTOR (TP-4).
3. Adjust R32 for T = 58 msec as shown Fig. 5-9.
4. Supply a PAL color bar signal, record, then playback in slow mode.
5. Adjust R35 for T = 63 msec in Fig. 5-9.

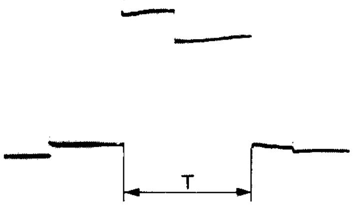


Fig. 5-9 Slow pulse

5.4.8 Slow tracking pre-set

1. Supply a SECAM color bar signal, record, then playback in slow mode.
2. Set the SLOW TRACKING VR to center click position.
3. Adjust R137 to obtain the best picture on the TV monitor.
4. Supply a NTSC color bar signal, record, then playback in slow mode.
5. Adjust R136 to obtain the best picture on the TV monitor.

5.4.9 FM noise pulse width

1. Supply a SECAM color bar signal, record, then playback in STILL mode.
2. Set the jig selector switch to FM NOISE (TP-24).
3. Adjust R141 for T = 10^{+5}_{-3} msec in the Fig. 5-10.

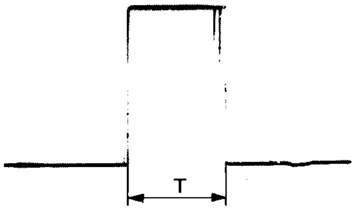


Fig. 5-10 FM noise pulse

5.4.10 Vertical pulse

1. Supply a SECAM color bar signal, record, then playback in STILL mode.
2. Trigger the oscilloscope externally with the signal from TP-111 (DRUM F.FLOP) of the Y & PRE/REC board and set the oscilloscope trigger slope to plus (+).
3. Connect oscilloscope to VIDEO OUT of the REAR CONNECTOR board.
4. Adjust R65 for T = 2.5 H in the Fig. 5-11.
5. Observe the picture dispaly and adjust R68 for minimum vertical jitter.

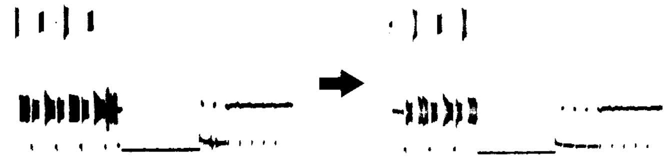

(Incorrect) (Correct)

Fig. 5-11 Vertical pulse

5.4.11 Shuttle search H discriminator

1. Play SECAM color bar segment of JVC MH-5 alignment tape.
2. Connect oscilloscope to TP-521 of the COLOR board.
3. Set the trigger slope to pulse (+) and synchronize the oscilloscope with the rising component of the waveform in the Fig. 5-12.

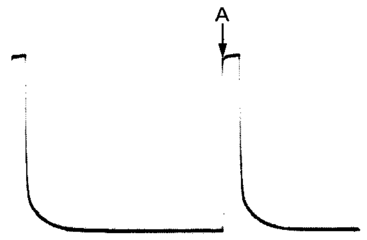


Fig. 5-12 H. sync signal

4. Set the front porch (point A) of the waveform to the center of the oscilloscope display, expand the waveform X5 (five times) and again center point A.
5. In the shuttle search FF mode, adjust R107 to position the front porch of the H sync waveform at point A (within ± 0.5 μsec). See Fig. 5-13.
6. Confirm the same value for the shuttle search REW mode.

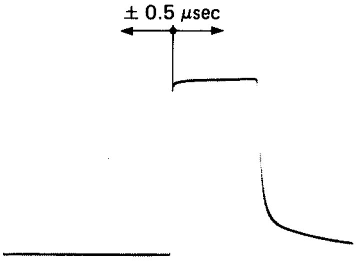


Fig. 5-13 H. discriminator

5.5 VIDEO CIRCUIT

Unless otherwise indicated, all test points and adjustments are located on the Y & PRE/REC, COLOR and and NTSC COLOR boards.

A: Playback system

[Y . . . Luminance signal]

5.5.1 Video head resonance, Q (quality factor) and FM equalizer

Note: This adjustment is generally unnecessary except when replacing the upper drum assembly.

– Factory service –

1. Set the SYSTEM SELECT switch to the PAL (MANUAL) position.
2. Apply the sweep signal from a video sweep generator to TP-222 (CH-1 REC OUT). Insert 1.0 MHz and 5 MHz markers.
3. Without inserting tape, set for Play mode. Then adjust the sweep gain so that the waveform does not distort at TP-106 (PB FM).
4. At TP-106, adjust C200 (CH-1 RESO) for maximum level at the 5 MHz marker portion.
5. Adjust R231 (CH-1 Q) so that the 5 MHz level becomes 2.5 times of the 1.0 MHz.

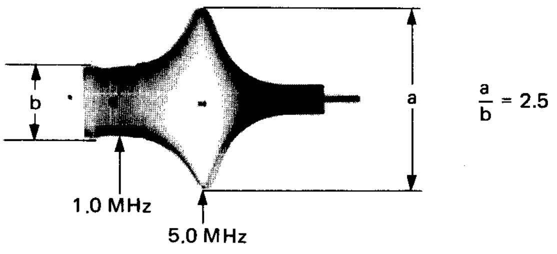


Fig. 5-14 Video head resonance and Q

6. In the same manner, adjust for CH-2. Apply sweep to TP-223 (CH-2 REC OUT) and adjust C202 (CH-2 RESO) and R232 (CH-2 Q).
7. Set the rear panel MODE SELECT SWITCH to B/W. Supply a video sweep signal with the sync signal, record then playback. Insert 100 kHz and 2 MHz markers.
8. At TP-00 (VIDEO OUT) measure earch 2 MHz level for CH-1 and CH-2 outputs. Adjust Q control (R231 and R232) of the lower level channel for equal level at both channels.
9. Adjust R153 (FM EQ) so that the 2 MHz level becomes 70% of the 100 kHz.

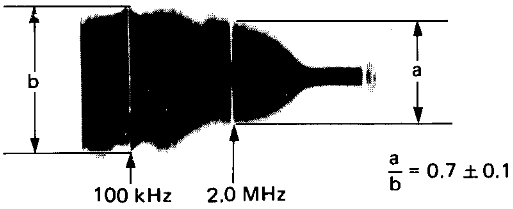


Fig. 5-15 Playback FM equalizer

— **Non-factory service** —

1. Play RF sweep segment of JVC MH-2 alignment tape. Trigger the oscilloscope externally with the drum flip-flop signal from TP-111 (DRUM F.FLOP).
2. Monitor TP-106 (PB FM) and turn R231 (CH-1 Q) and R232 (CH-2 Q) fully counter clockwise in order to boost the highband frequency component.
3. Set the oscilloscope sync slope to minus (–) and adjust C200 (CH-1 RESO) to set the CH-1 resonance point to 5.0 MHz marker portion.
4. Set the oscilloscope sync slope to plus (+) and adjust C202 (CH-2 RESO) to set the CH-2 resonance point to 5.0 MHz.

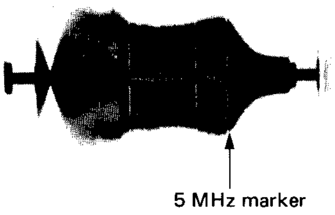


Fig. 5-16 Video head resonance (with alignment tape)

5. Set R231 and R232 (HEAD Q) to mechanical center.
6. Measure each 5 MHz FM level for CH-1 and CH-2 at TP-106 and adjust Q control (R231 or R232) of the lower level channel for equal level at both channels.

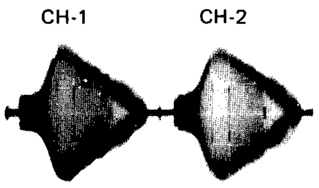


Fig. 5-17 Video head Q (with alignment tape)

7. Record an off-the-air signal, then playback. While observing the picture, adjust R153 (FM EQ) for optimum clarty. (This adjusts the sharpness and softness of the playback picture.)

5.5.2 Noise canceller

1. Connect a 0.022 μF capacitor between TP-1 and TP GND of the VIDEO SUB board.
2. Play color bar segment of JVC MH-2 alignment tape.
3. At TP-1 (NOISE CLIP), adjust R11 (NOISE CANCEL to minimize the output level.
4. Remove the capacitor between TP-1 and TP-GND.

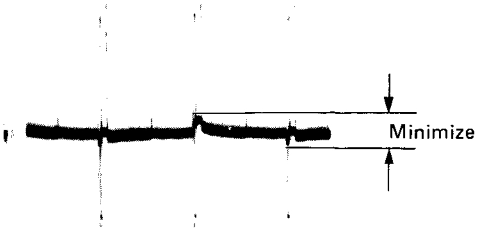


Fig. 5-18 Noise canceller

5.5.3 Playback Y level

1. Play color bar segment of JVC MH-2 alignment tape.
2. Adjust R101 (PB Y LEVEL CCIR) for 1.9 Vp-p a TP-1 (VIDEO OUT) of the REAR CONN. board withou load as shown in Fig. 5-19.
3. Play NTSC color bar segment of JVC MH-5 alignmen tape.
4. Adjust R105 (PB Y LEVEL NTSC) for 1.9 Vp-p a TP-1 (VIDEO OUT) of the REAR CONN. board withou load as shown in Fig. 5-19.

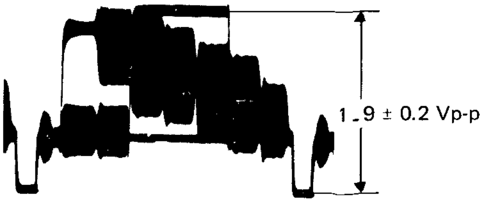


Fig. 5-19 PB Y level

[Color signal]

5.5.4 Playback subcarrier oscillator

1. Set the SYSTEM SELECT switch for NTSC (MODF. position.
2. Play NTSC color bar segment of JVC MH-5 alignmen tape and connect a frequency counter to TP-603.
3. Adjust R611 for 4.433619 MHz ± 50Hz.

5.5.5 PAL AFC (Automatic Freqency Control)

1. Set the SYSTEM SELECT switch for AUTO position.
2. Supply a PAL color bar signal and set for the STOP (E-E) mode.
3. Connect a 680Ω resistor between TP-603 and TP-622.
4. Connect a freqency counter to TP-612 and adjust R624 for 625 kHz ± 2 kHz.
5. Remove a resistor between TP-603 and TP-622.

5.5.6 PAL VXO (Variable Crystal Oscillator)

1. Supply a PAL color bar signal and set for the STOP (E-E) mode.
2. Connect a frequency counter to TP-612.
3. Adjust C602 for 4.435571 MHz ± 50 Hz.

5.5.7 NTSC AFC (Automatic Frequency Control)

1. Set the SYSTEM SELECT switch for NTSC (STD.) position.
2. Supply a NTSC color bar signal and set for the STOP (E-E) mode.
3. Connect a 680Ω resistor between TP-403 and TP-422.
4. Connect a frequency counter to TP-412 and adjust R491 for 629 kHz ± 2 kHz.
5. Remove the resistor between TP-403 and TP-422.

5.5.8 NTSC VXO (Variable Cyrstal Oscillator)

1. Play NTSC color bar segment of JVC MH-5 alignment tape.
2. Connect a frequency counter to TP-403.
3. Adjust R408 for 3.579545 MHz ± 50 Hz.

B: Recording system

[Y . . . Luminance signal]

5.5.9 Carrier and deviation

NOTE: These adjustments are generally unnecessary except when replacing IC106 or IC107. Before adjustment, turn R216 (WHITE CLIP) and R219 (DARK CLIP) fully counterclockwise.

1. Supply a PAL color bar signal and set for the STOP (E-E) mode.
2. Connect oscilloscope to IC107 pin 18 and precisely measure the DC potential of the sync tip. Make a note of this as voltage "A".

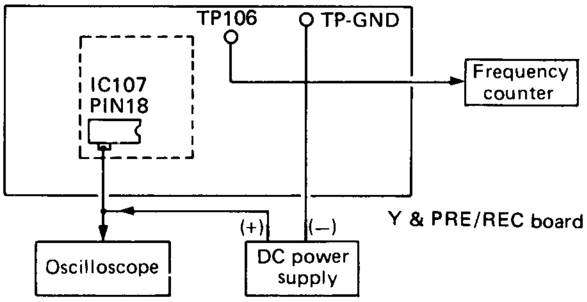


Fig. 5-20 Carrier and deviation

3. Connect a DC power supply between IC107 pin 18 and ground. Without an input signal, set for the STOP (E-E) mode and precisely apply sync tip bias "A" as observed with the oscilloscope.
4. Connect a frequency counter to TP-106 (REC FM IN) and adjust R291 (CARRIER) for 3.8 MHz $^{+0}_{-50}$ kHz.
5. Supply a NTSC color bar signal set for the STOP (E-E) mode.
6. Similarity apply sync tip bias "A" as observed with the oscilloscope.
7. Adjust R293 for 3.4 MHz ± 30 kHz.
8. Carefully adjust the DC power supply to obtain 4.4 MHz ± 30 kHz at TP-106 (REC FM IN). Precisely read the voltage of IC107 pin 18 with the oscilloscope. Make a note of this as voltage "B".
9. Disconnect the DC power supply. Supply a color bar signal and set for the STOP (E-E) mode.
10. Adjust R203 (DEVIATION) so that the white peak at IC205 pin 18 becomes equal to voltage "B".
11. About step 8, 9, 10, f = 4.8 MHz $^{+0}_{-50}$ kHz, set the input signal PAL color bar and adjust R201 like the above example.

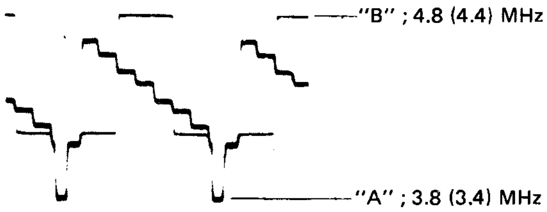
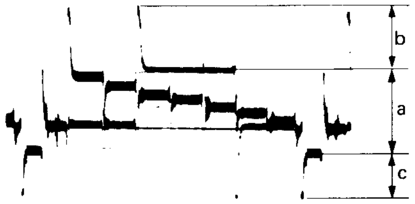


Fig. 5-21 FM modulation

5.5.10 White and dark clip

1. Supply a PAL color bar signal and set for the STOP (E-E) mode.
2. At TP-103 (W/D CLIP OUT), with the rated signal level taken as 100%, adjust R216 (WHITE CLIP) so that the white peak overshoot becomes 80% as shown in Fig. 5-22.
3. In the same condition, adjust R219 (DARK CLIP) so that the sync tip undershoot becomes 40%.



White clip
a : b = 1 : 0.8 ± 0.02
Dark clip
a : c = 1 : $0.4^{+0.05}_{-0}$

Fig. 5-22 White and dark clip

5.5.11 Recording FM level

1. Supply a NTSC color bar signal and set for the Recording mode.
2. Adjust R249 so that the pedestal level of the vertical blanking component becomes 4.4 V at TP222 or TP-223 of the VIDEO HEAD board.
3. Supply a PAL color bar signal and set for the recording mode.
4. Similarity adjust R251 that the pedestal level becomes 3.8 V.

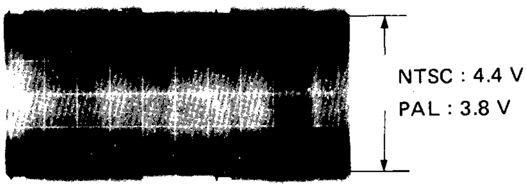


Fig. 5-23 Recording FM level

5.5.12 E-E video level

1. Supply a PAL color bar signal and set for the STO (E-E) mode.
2. Adjust R189 (E-E LEVEL) for 1.9 Vp-p at TP- (VIDEO OUT) of the REAR CONNECTOR boar without load.

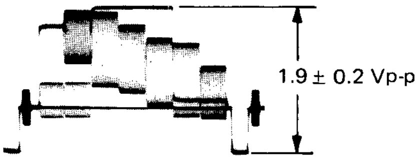
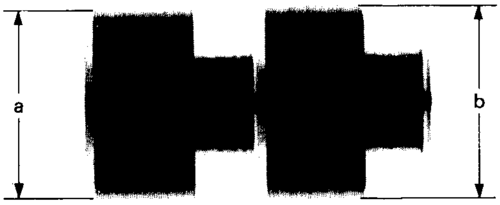


Fig. 5-24 E-E video signal

[Color signal]

5.5.13 PAL Recording color level

1. Play color bar segment of JVC MH-2 alignment tape an connect oscilloscope to TP-604.
2. Measure the average of CH-1 output "a" and CH- output "b". See Fig. 5-25. Make a note of this as leve "c".



$$c = \frac{a+b}{2}$$

Fig. 5-25 PAL Recording color level

3. Supply a PAL color bar signal, record, then playback.
4. During recording, adjust R671 so that during playback the average of CH-1 output and CH-2 output become 100% with respect to level "c" at TP-604, i.e., adjus during recording and check during playback.

5.5.14 PAL converter valance

1. Supply a PAL color bar signal, record, then playback.
2. Connect oscilloscope to TP-621.
3. Adjust R621 for minimum leakage of the 5.1 MH component.

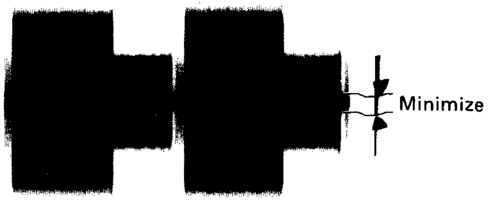


Fig. 5-26 PAL converter valance

5.5.15 PAL PB burst level

1. Supply a PAL color bar signal, record, then playback.
2. Connect oscilloscope to TP-1 (VIDEO OUT) of the REAR CONNECTOR board.
3. Adjust R616 for 0.5 ± 0.04 V of burst signal without load.

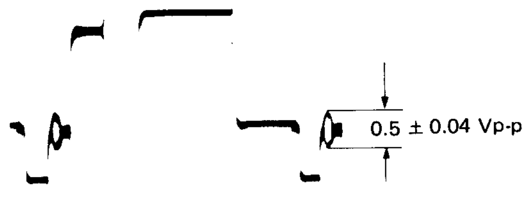
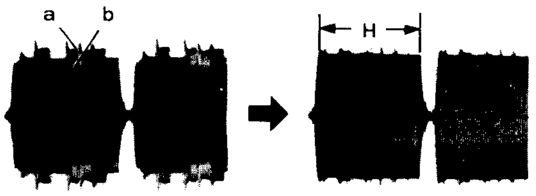


Fig. 5-27 PAL PB burst level

5.5.16 REC input bell

1. Supply a SECAM color bar signal and set for the STOP (E-E) mode.
2. Adjust L501 for minimum amplitude difference between (a) and (b) at TP-501 as shown Fig. 5-28.

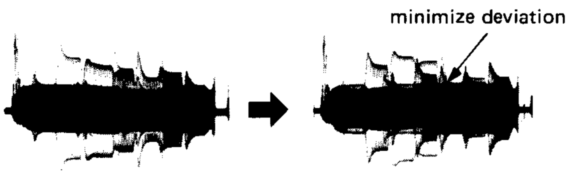


(incorrect) (correct)

Fig. 5-28 REC input bell

5.5.17 REC output bell

1. Supply a SECAM color bar signal and set for the STOP (E-E) mode.
2. Adjust L502 so that the amplitude of line (n) violet and line (n + 1) violet are equal to each other at TP-502 as shown Fig. 5-30.



(incorrect) (correct)

Fig. 5-29 REC output input bell

5.5.18 SECAM recording color level

1. Play SECAM color bar segment of JVC MH-5 alignment tape and connect oscilloscope to TP-501.
2. Measure the average of CH-1 output "a" and CH-2 output "b". See Fig. 5-30. Make a note of this as level "c".

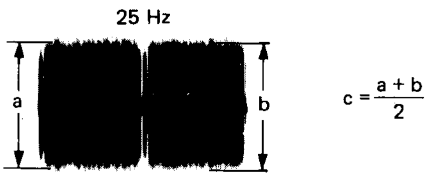


Fig. 5-30 SECAM recording color level

3. Supply a SECAM color bar signal, record, then playback.
4. During recording, adjust R545 so that during playback, the average of CH-1 output and CH-2 output becomes 140 ± 10% with respect to level "c" at TP-501, i.e., adjust during recording and check during playback.

5.5.19 SECAM playback color level

1. Supply a SECAM color bar, record, then playback.
2. Connect oscilloscope to TP-1 (VIDEO OUT) of the REAR CONNECTOR board.
3. Adjust R543 to obtain a violet level of 0.4 V without load.

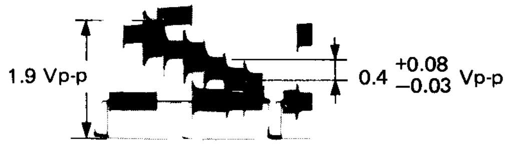


Fig. 5-31 SECAM playback color level

5.5.20 SECAM detector-1

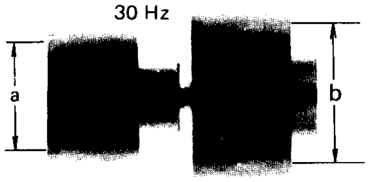
1. Set the SYSTEM SELECT switch for SECAM (STD.) position.
2. Play SECAM color bar segment of JVC MH-5 alignment tape.
3. Adjust R554 for 6.0 ± 0.5 VDC at TP-522.

5.5.21 SECAM detector-2

1. Set the SYSTEM SELECT switch for SECAM (MODF.) position.
2. Supply a SECAM color bar signal, record, then palyback.
3. Adjust R683 for 6.0 ± 0.5 VDC at TP-623.

5.5.22 NTSC recoring color level

1. Play NTSC color bar segment of JVC MH-5 alignment tape and connect oscilloscope to TP-404.
2. Measure the average of CH-1 output "a" and CH-2 output "b". See Fig. 5-32. Make a not of this as level "a".



$$C = \frac{a+b}{2} = 0.2 \pm 0.02 \text{ Vp-p}$$

Fig. 5-32 NTSC recording color level

3. Supply a NTSC color bar signal, record, then playback.
4. During recording, adjust R452 so that during playback, the average of CH-1 output and CH-2 output becomes 100% with respect to level "c"at TP-404, i.e., adjust during recording and check during playback.

5.5.23 NTSC converter valance

1. Supply a NTSC color bar signal, record, then playback.
2. Connect oscilloscope to TP-421.
3. Adjust R404 for minimum leakage of the 4.2 MHz compornent.

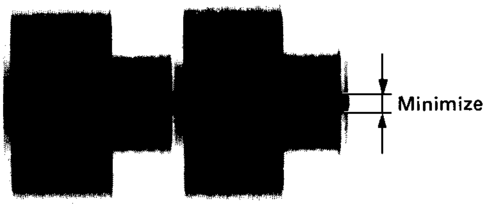


Fig. 5-33 NTSC converter valance

5.5.24 NTSC playback burst level

1. Supply a NTSC color bar signal, record, then playback.
2. Connect oscilloscope to TP-1 (VIDEO OUT) of th
REAR CONNECTOR board.
3. Adjust R700 for 0.54 ± 0.1 V of burst signal withou
load.

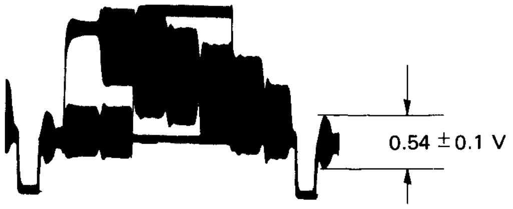


Fig. 5-34 NTSC playback burst level

5.6 AUDIO CIRCUIT

Unless otherwise indicated, all test points and adjustments are located on the AUDIO board.

5.6.1 Playback level

1. Play 1 kHz audio signal segment of JVC MH-2 alignment tape.
2. Adjust R70 (PLAY LEVEL) for −6 ± 1 dBs at AUDIO OUT terminal (CONN. 42).

5.6.2 Bias level

1. Set for the Recording mode without signal.
2. Connect a digital voltmeter between CONN. 112 and CONN. 111 on the AUDIO/CTL HEAD board.
3. Adjust R125 for 2.0 ± 0.1 mV (RMS).

5.6.3 Recording level and equalizer

1. Set the SYSTEM SELECT switch to the PAL (MANUAL) position.
2. Supply a PAL video signal and a 1 kHz audio signal at −20 dBs and record, then playback.
3. During recording, adjust R93 (REC LEVEL CCIR) to obtain −6 ± 1 dBs at AUDIO OUT terminal during playback, i.e., adjust during recording and check during playback.
4. Supply 1 kHz and 10 kHz audio signals at −30 dBs and record, then playback.
5. During recording, adjust R95 (REC EQ CCIR) so that during playback, 10 kHz level becomes $^{+0}_{-3}$ dB of the 1 kHz level at the AUDIO OUT terminal, i.e., adjust during recording and check during playback.
6. Set the SYSTEM SELECT switch to the NTSC (MANUAL) position.
7. Supply a NTSC video signal and a 1 kHz audio signal at −20 dBs and record, then playback.
8. During recording, adjust R163 (REC LEVEL NTSC) to obtain −6 ± 1 dBs at AUDIO OUT terminal during playback, i.e., adjust during recording and check during playback.
9. Supply 1 kHz and 10 kHz audio signals at −30 dBs and record, then playback.
10. During recording, adjust R160 (REC EQ NTSC) so that during playback, 10 kHz level becomes $^{+0}_{-3}$ dB of the 1 kHz level at the AUDIO OUT terminal, i.e., adjust during recordig and check during playback.

5.7 TUNER/IF CIRCUIT

Unless otherwise indicated, all test points and adjustments are located on the TUNER/IF board.

5.7.1 Equipment required

1. Oscilloscope
2. IF sweep signal generator with suitable markers (PIF, SIF, etc.)
3. DC power supplies — for power bias (12.0 V)
   — For IF AGC bias (approx. 5 V variable)
4. Sweeper probe (sweep signal supply cable) as shown in Fig. 5-35.

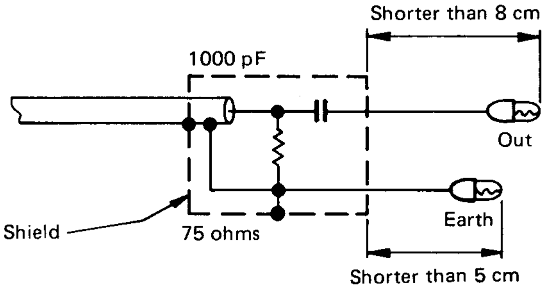


Fig. 5-35 Sweeper probe

5.7.2 IF

1. Disengage the connectors from TUNER/IF board and remove the TUNER/IF board.
2. Apply POWER bias 12.0 V DC between CONN. 23 (ALL 12 V IN) and CONN. 21 (GND).
3. Apply AGC bias 5 V DC between TP14 (IF AGC) and GND.
4. Connect a wire between CONN. 43 (TUNER CTL IN) and CONN. 42 (GND).
5. Connect the sweep generator output to test point (TP1) of TUNER and the oscilloscope to TP12 (P. DET OUT).
6. Adjust the sweep gain so that the waveform does not distort as observed with the oscilloscope.
   Adjust AGC bias for 1 $V_{p\text{-}p}$ at TP12 (P. DET OUT).
7. Adjust T3 (P. DET) so that video IF carrier 38.9 MHz marker becomes maximum level.
8. Adjust tuner module core so that 38.15 MHz marker comes to the top of the waveform.
9. Adjust T1 so that 38.15 MHz marker becomes maximum level.

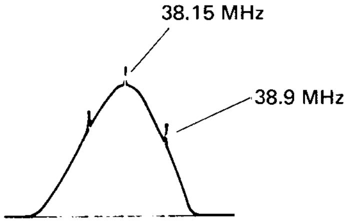


Fig. 5-36 IF adjustment

5.7.3 RF AFC

1. In the same manner as above step 5.7.2, connect the sweep generator and power supplies.
2. Connect the oscilloscope to IC1 pin 10 (AFC OUT).
3. Adjust the sweep gain so that the "S" curve indicated in Fig. 5-37 appears as observed with the oscilloscope.
   Adjust AGC bias so that the "S" curve does not distort.
4. Adjust T2 (AFC) so that video IF carrier (38.9 MHz) becomes 6.5 VDC as shown in Fig. 5-37.

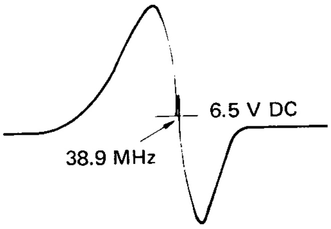


Fig. 5-37 S curve for RF AFC

5.7.4 Noise VR

Adjust the NOISE VR to correct for excess noise in the picture or streaky cross interference due to strong electric fields.

1. Receive a color broadcast and adjust R9 (NOISE) to minimize noise or streaks.
2. Check for absence of abnormality on all channels.

5.7.5 Color output level

1. Use a TV channel signal generator to supply color bar and 1 kHz audio RF signals.
2. At TP13 (VIDEO OUT), with the rated signal level taken as 100%, adjust R34 (COLOR LEVEL) so that the magenta component becomes 45%.

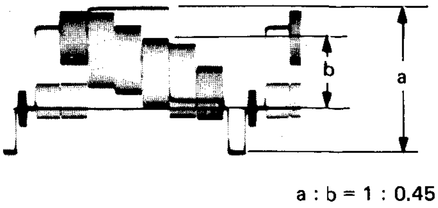


Fig. 5-38 Video output level

5.7.6 Audio output level

Under the conditions as above section, adjust R4 (AUDIO LEVEL) for −14 dBs (0.44 Vp-p) at TP2 (AUDIO OUT).

5.8 TUNER/TIMER CTL CIRCUIT

Unless otherwise indicated, all test points and adjus ments are located on the TUNER/TIMER CTL boarc Set for the Stop (E-E) mode.

5.8.1 DAC (digital to analog converter) clock

1. Connect oscilloscope to IC202 pin 3 and connect th signal output terminal of the oscilloscope to a frequenc counter.
2. Check for frequency of 1.3 MHz ±0.1 MHz and level c more than 3 Vp-p.

5.8.2 Timer CTL clock

1. Connect oscilloscope to TP201 (TIMER CTL CLOCK and connect the signal output terminal of the oscillc scope to a frequency counter.
2. Adjust C233 (3.84 MHz ADJ) to obtain 3,840,000 H ± 10 Hz.

5.8.3 Tuner CTL clock

1. Connect oscilloscope to IC207 pin 1 and connect th signal out terminal of the oscilloscope to a frequenc counter.
2. Confirm frequency of 400 kHz ±10 kHz and level c more than 6 Vp-p.

5.8.4 BT (band tuning voltage)

1. Connect oscilloscope to CONN. 89 (BT OUT) and set the CH PRESET switch to ON.
2. Set the Band Select switch to I (VHF channels 2 to 4) and turn the Tuning control fully counter-clockwise. Confirm DC voltage of 0.6 V.
3. Set the Band Select switch to U (UHF channels 21 to 69) and turn the Tuning control fully clockwise. Confirm DC voltage of 29 V.

5.8.5 BV, BS and BU

1. Set the CH PRESET switch to ON and the Band Select switch sequentially to positions I, III and U.
2. Use a digital voltmeter and measure the voltages at tuner BV, BS and BU terminals. Check for values indicated in Table 5-2.

Voltage / Band	BV	BS	BU
I (V_L)	More than 11.5 V	More than 30 V	Less than 0.8 V
III (V_H)	More than 11.5 V	Less than 0.8 V	Less than 0.8 V
U	Less than 0.8 V	Less than 0.8 V	More than 11.5 V

Table 5-2 BV, BS and BU voltages

5.8.6 Display clock

1. Connect oscilloscope to IC401 pin 1 of the DISPLAY board and connect the signal out terminal of the oscilloscope to a frequency counter.
2. Confirm oscillation frequency of 400 kHz ±10 kHz and level of more than 6.0 Vp-p.

SECTION 6
SCHEMATIC AND CIRCUIT BOARD DIAGRAMS

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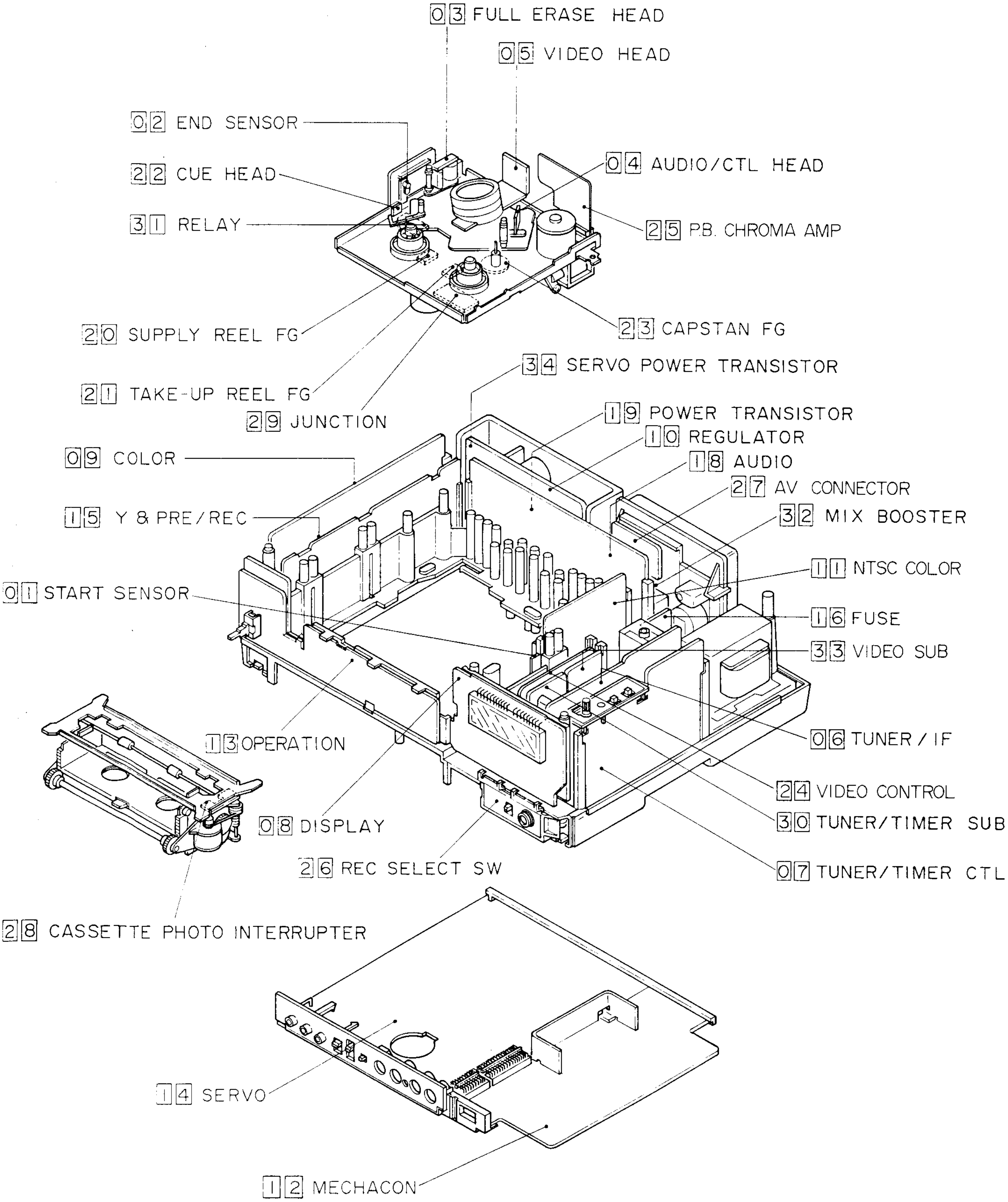
PARTS MARKED ▨ ARE CRITICAL FOR SAFETY.
REPLACE ONLY WITH SPECIFIED PART NUMBERS.

6 . 1 CIRCUIT BOARD


03 FULL ERASE HEAD
05 VIDEO HEAD
02 END SENSOR
22 CUE HEAD
04 AUDIO/CTL HEAD
31 RELAY
25 P.B. CHROMA AMP
20 SUPPLY REEL FG
23 CAPSTAN FG
34 SERVO POWER TRANSISTOR
21 TAKE-UP REEL FG
19 POWER TRANSISTOR
29 JUNCTION
10 REGULATOR
09 COLOR
18 AUDIO
27 AV CONNECTOR
15 Y & PRE/REC
32 MIX BOOSTER
11 NTSC COLOR
01 START SENSOR
16 FUSE
33 VIDEO SUB
13 OPERATION
06 TUNER / IF
24 VIDEO CONTROL
08 DISPLAY
30 TUNER/TIMER SUB
26 REC SELECT SW
07 TUNER/TIMER CTL
28 CASSETTE PHOTO INTERRUPTER
14 SERVO
12 MECHACON

6.2 DEY TO ABBERVIATIONS (reference)

A	AC	Alternating Current
	ACC	Automatic Color Control
	A/CTL	Audio/Control
	A. DUB	Audio Dubbing
	AE	Audio Erase
	AFC	Automatic Frequency Control
	AGC	Automatic Gain Control
	AL	After Loading
	ALL	Always
	AMP	Amplifier
	ANT	Antenna
	APC	Automatic Phase Control
	AR	After Recording
	AUX	Auxiliary
B	B	Base
	BAL	Balance
	BLK	Black
	BLU	Blue
	BPF	Band-Pass Filter
	BRN	Brown
	B. SOL	Brake Solenoid
	B/W	Black and White
C	CAP	Capstan
	CARR	Carrier
	CASS	Cassette
	CD	Count Down
	CF	Ceramic Filter
	CH	Channel
	COL	Color (Colour)
	COMP	Comparator
	CONN	Connector
	CONV	Converter
	COUNT SEA	Counter Search
	C. PAUSE	Camera Pause
	C. SW	Cassette Switch
	CTL	Control
D	DAC	Digital to Analog Converter
	DEMOD	Demodulator
	DET	Detector
	DL	Delay Line
	DOC	Drop Out Compensator
	D. PU	Drum Pick-up
	DRUM FF	Drum Flip-Flop
E	EF	Emitter Follower
	EMPHA	Emphasis
	EQ	Equalizer
	E. SENS	End Sensor
	E. SW	Electronic Switch
F	F	Fuse
	F. ADV	Frame Advance
	FE	Full Erase
	FF	Fast Forward Flip-Flop
	FG	Frequency Generator
	FM	Frequency Modulation
	FR	Full Recording
	FWD	Forward
G	GEN	Generator
	GND	Ground
	GRN	Green
	GRY	Gray
H	HG	Hall Generator
	HPF	High-Pass Filter
I	ID	Identification
	IF	Intermediate Frequency
	IND	Indicator
	INV	Inverter
J	–	–
K	–	–
L	L	Low
	LED	Light Emitting Diode
	LOAD	Loading
	LPF	Low-Pass Filter
M	M.	Motor
	MDA	Motor Drive Amplifier
	MECHACON	Mechanism Control
	MIC	Microphone
	MIX	Mixer, Mixing
	MMV	Monostable Multivibrator
	MOD	Modulator
	MUTE	Muting
N	NC	Non Connection
	NON-LIN	Non-Linear
O	OP	Operation
	ORN	Orange
	OSC	Oscillator
P	PB	Playback
	PI	Photo Interrupter
	PR	Pinch Roller
	P/S	Pause/Still
	P. TR	Power Transistor
	PU	Pick-up
	PWB	Printed Wiring Board
Q	–	–
R	REC	Recording (Record)
	RED	Red
	REG	Regulator
	REV	Reverse
	REW	Rewind
	RF	Radio Frequency
	R/P	Record/Playback
	RT	Rotary Transformer
	RUN IND	Running Indicator
	RY	Relay
S	SAFE	Safety
	SEAR	Search
	SEC	Second

	SEL	Select
	SENS	Sensor
	SF	Source Follower
	SOL	Solenoid
	S. R	Supply Reel
	S. SENS	Start Sensor
	S. SEP	Sync Separator
	SW	Switch
T	T. E ALM	Tape End Alarm
	TP	Test Point
	TR	Transistor
	TRANS	Transformer
	T. REC	Timer Record
	T. SW	Timer Switch
	T/T	Tuner/Timer
	TU	Take-up
	TU. R	Take-up Reel
U	UL	Unloading

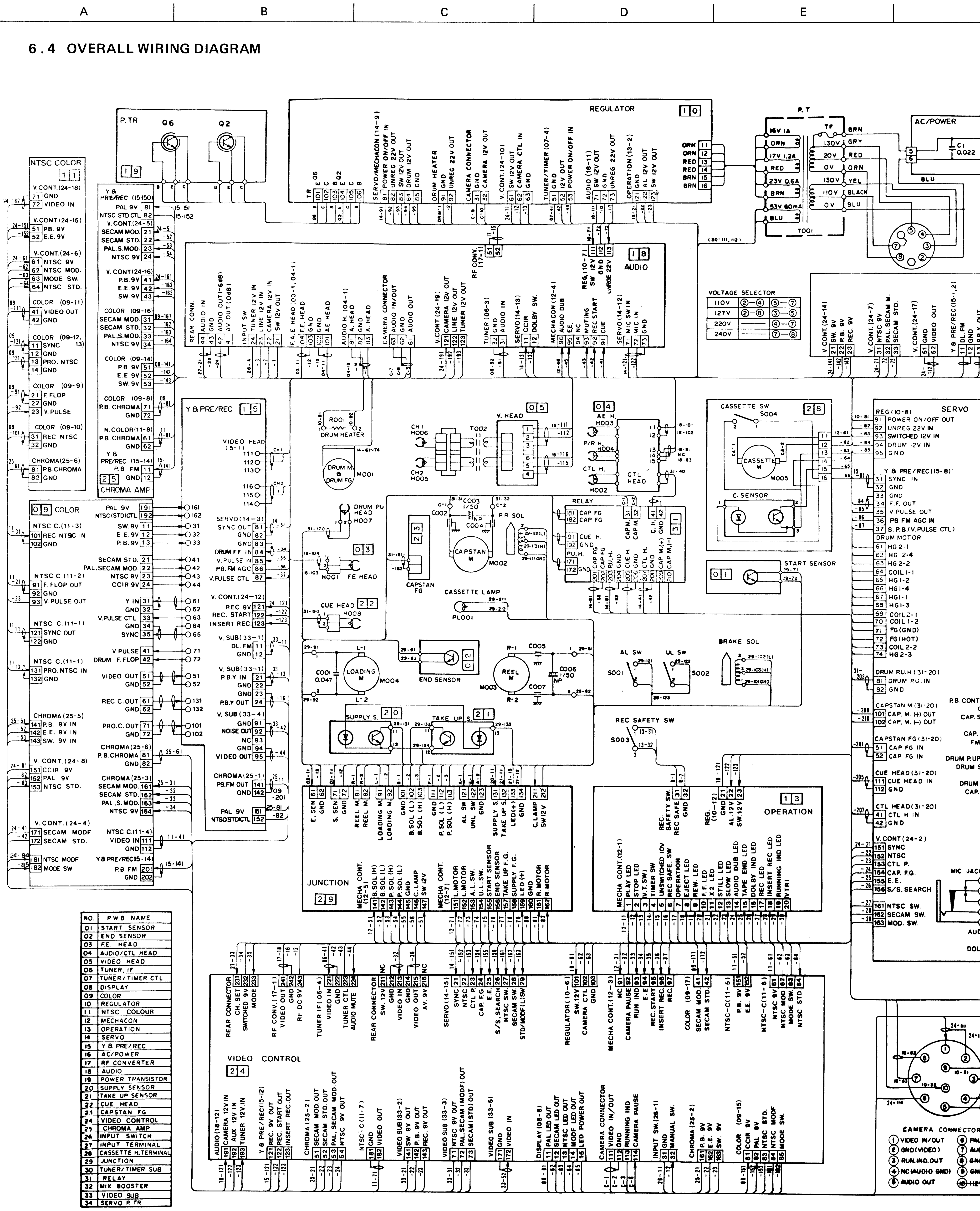
V	V	Volt
	VCO	Voltage Controlled Oscillator
	VLT	Violet
	V. PULSE	Vertical Pulse
	V. SEL	Video Select
	V/T	Video/Television
	V/U	VHF/UHF
	VXO	Variable Crystal Oscillator
W	W	Watt
	W/D	White and Dark
	WHT	White
Y	Y	Luminance
	YLW	Yellow
Z	–	–

6.3 INTRODUCTION

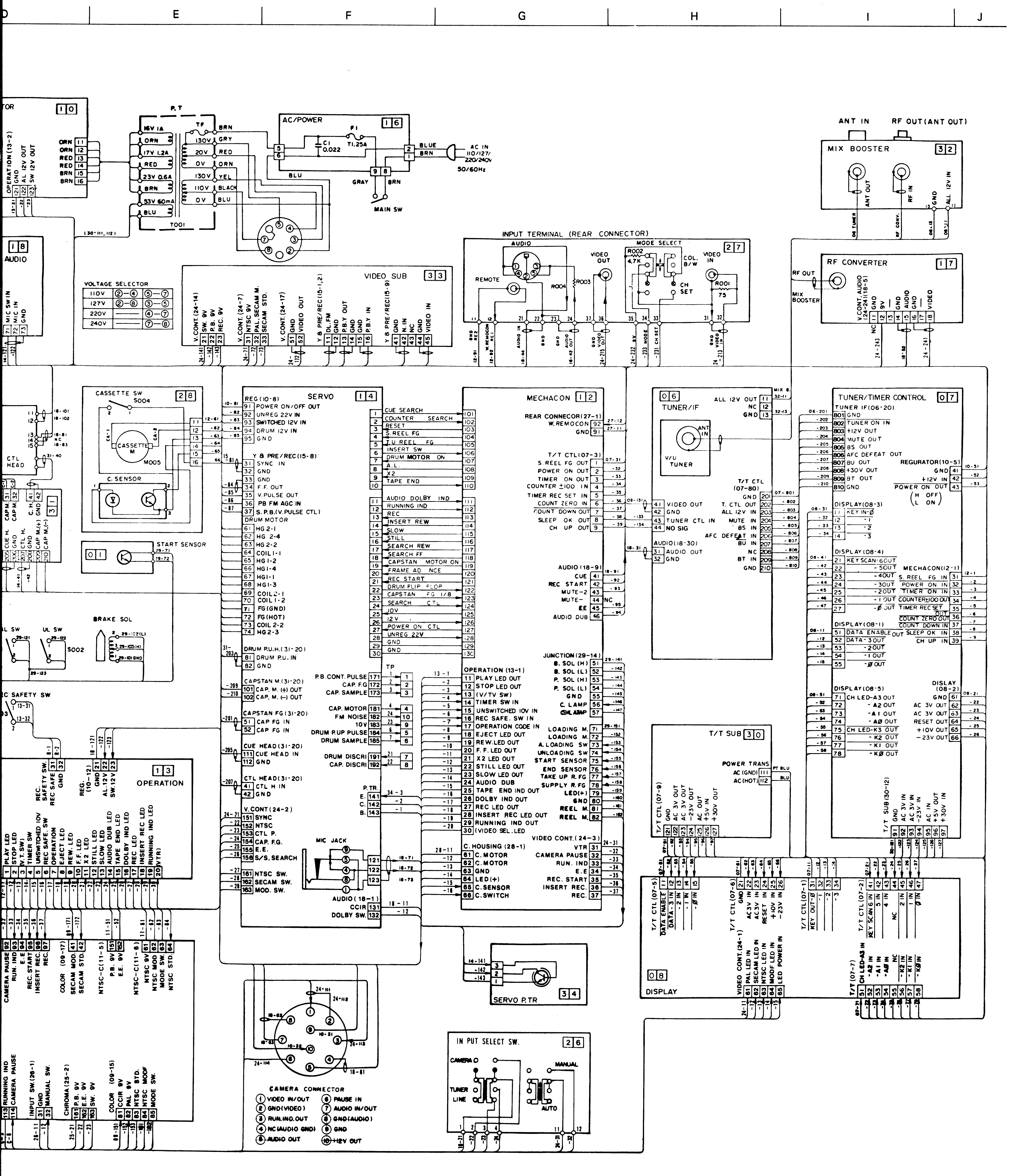
The colors used in printing this manual, where not otherwise indicated, signify as follows.

COLORS	SCHEMATIC DIAGRAM	CIRCUIT BOARD
Grey shading ▨	Critical component parts. Parts marked ▨ are critical for safety. Replace only with specified part numbers.	None
Red ■	DC and AC voltages DC power supply informations Adjustment point locations	DC and AC voltages Adjustment part symbol numbers and names
Red shading ▨ ▒	Always (unswitched) power supply lines Switched power supply lines	Integrated circuits, transistor and connectors
Blue ▨	Technical informations, test points and circuit names	None
Blue shading ▒	Main and sub signal lines	None
Green shading ░	None	Circuit board patterns

6.4 OVERALL WIRING DIAGRAM


A
B
C
D
E
1
2
3
4
5
6
7
P.TR
Q6
Q2
19
REGULATOR
10
P.T
T001
AC/POWER
NTSC COLOR
11
AUDIO
18
VOLTAGE SELECTOR
Y & PRE/REC
15
25
CHROMA AMP
09
COLOR
DRUM HEATER
DRUM M & DRUM FG
M001
V. HEAD
05
04
AE H.
P/R H.
CTL H.
CTL HEAD
CASSETTE SW
S004
28
CASSETTE M
M005
C. SENSOR
SERVO
DRUM PU HEAD
H007
FE HEAD
H001
03
23
CAPSTAN M
M002
P.R. SOL
RELAY
31
START SENSOR
01
CAPSTAN FG
CUE HEAD
H008
22
CASSETTE LAMP
PL001
LOADING M
M004
END SENSOR
02
REEL M
M003
AL SW
S001
UL SW
S002
BRAKE SOL
SUPPLY S.
20
TAKE UP S.
21
REC SAFETY SW
S003
JUNCTION
29
OPERATION
13
VIDEO CONTROL
24
MIC JACK
CAMERA CONNECTOR

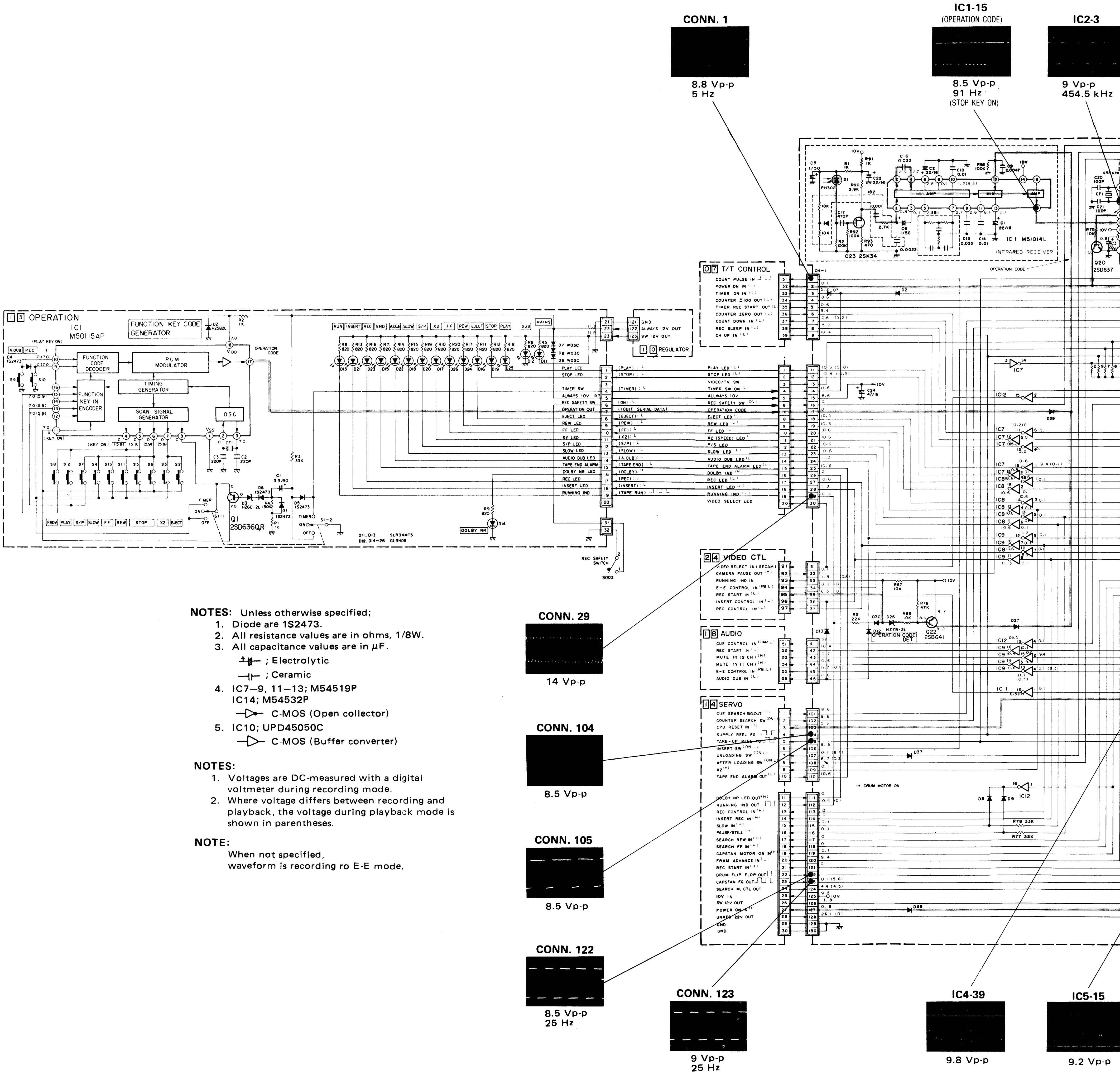
NO.	P.W.B NAME
01	START SENSOR
02	END SENSOR
03	F.E. HEAD
04	AUDIO/CTL HEAD
05	VIDEO HEAD
06	TUNER, IF
07	TUNER/TIMER CTL
08	DISPLAY
09	COLOR
10	REGULATOR
11	NTSC COLOUR
12	MECHACON
13	OPERATION
14	SERVO
15	Y & PRE/REC
16	AC/POWER
17	RF CONVERTER
18	AUDIO
19	POWER TRANSISTOR
20	SUPPLY SENSOR
21	TAKE UP SENSOR
22	CUE HEAD
23	CAPSTAN FG
24	VIDEO CONTROL
25	CHROMA AMP
26	INPUT SWITCH
27	INPUT TERMINAL
28	CASSETTE H.TERMINAL
29	JUNCTION
30	TUNER/TIMER SUB
31	RELAY
32	MIX BOOSTER
33	VIDEO SUB
34	SERVO P. TR


D
E
F
G
H
I
J
P.T
TF
T001
AC/POWER 16
F1 T1.25A
C1 0.022
AC IN 110/127/220/240V 50/60Hz
MAIN SW
ANT IN
RF OUT (ANT OUT)
MIX BOOSTER 32
VOLTAGE SELECTOR
VIDEO SUB 33
INPUT TERMINAL (REAR CONNECTOR) 27
MODE SELECT
RF CONVERTER 17
CASSETTE SW S004 28
C. SENSOR
M005
START SENSOR 01
BRAKE SOL
S002
SERVO 14
MECHACON 12
TUNER/IF 06
V/U TUNER
TUNER/TIMER CONTROL 07
T/T SUB 30
POWER TRANS
OPERATION 13
MIC JACK
SERVO P.TR 34
CAMERA CONNECTOR
① VIDEO IN/OUT
② GND (VIDEO)
③ RUN.IND.OUT
④ NC (AUDIO GND)
⑤ AUDIO OUT
⑥ PAUSE IN
⑦ AUDIO IN/OUT
⑧ GND (AUDIO)
⑨ GND
⑩ +12V OUT
IN PUT SELECT SW. 26
CAMERA
TUNER LINE
MANUAL
AUTO
DISPLAY 08

OVERALL WIRING (MECHACON, OPERATION)

6 . 5 MECHACON AND OPERATION CIRCUITS

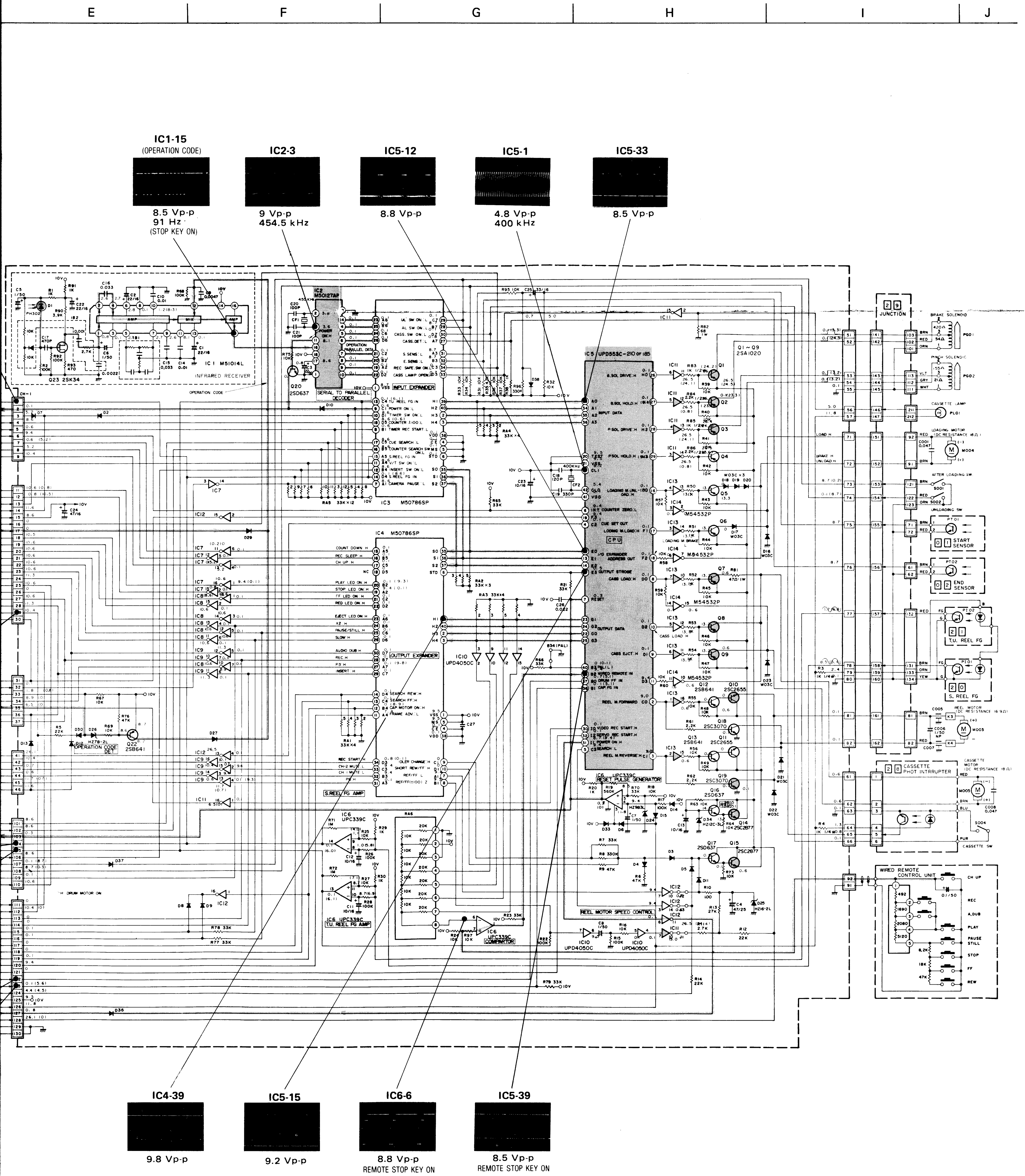
6 . 5 . 1 Schematic diagram


CONN. 1
8.8 Vp-p
5 Hz
IC1-15
(OPERATION CODE)
8.5 Vp-p
91 Hz
(STOP KEY ON)
IC2-3
9 Vp-p
454.5 kHz
IC1 M51014L
INFRARED RECEIVER
Q23 2SK34
Q20
2SD637
07 T/T CONTROL
COUNT PULSE IN
POWER ON IN
TIMER ON IN
COUNTER ±100 OUT
TIMER REC START OUT
COUNTER ZERO OUT
COUNT DOWN IN
REC SLEEP IN
CH UP IN
10 REGULATOR
GND
ALWAYS 12V OUT
SW 12V OUT
13 OPERATION
IC1
M50115AP
FUNCTION KEY CODE GENERATOR
FUNCTION CODE DECODER
PCM MODULATOR
TIMING GENERATOR
FUNCTION KEY IN ENCODER
SCAN SIGNAL GENERATOR
OSC
OPERATION CODE
Q1
2SD636QR
FADV PLAY S/P SLOW FF REW STOP X2 EJECT
RUN INSERT REC END ADUB SLOW S/P X2 FF REW EJECT STOP PLAY SUB MAINS
D11, D13 SLR34MT5
D12, D14–26 GL3H05
DOLBY NR
PLAY LED
STOP LED
TIMER SW
ALWAYS 10V
REC SAFETY SW
OPERATION OUT
EJECT LED
REW LED
FF LED
X2 LED
S/P LED
SLOW LED
AUDIO DUB LED
TAPE END ALARM
DOLBY NR LED
REC LED
INSERT LED
RUNNING IND
VIDEO SELECT LED
REC SAFETY SWITCH
S003
24 VIDEO CTL
18 AUDIO
14 SERVO
OPERATION CODE DET
Q22
2SB641
IC7
IC8
IC9
IC11
IC12
CONN. 29
14 Vp-p
CONN. 104
8.5 Vp-p
CONN. 105
8.5 Vp-p
CONN. 122
8.5 Vp-p
25 Hz
CONN. 123
9 Vp-p
25 Hz
IC4-39
9.8 Vp-p
IC5-15
9.2 Vp-p

NOTES: Unless otherwise specified;
1. Diode are 1S2473.
2. All resistance values are in ohms, 1/8W.
3. All capacitance values are in μF.
   ; Electrolytic
   ; Ceramic
4. IC7–9, 11–13; M54519P
   IC14; M54532P
   —▷— C-MOS (Open collector)
5. IC10; UPD45050C
   —▷— C-MOS (Buffer converter)

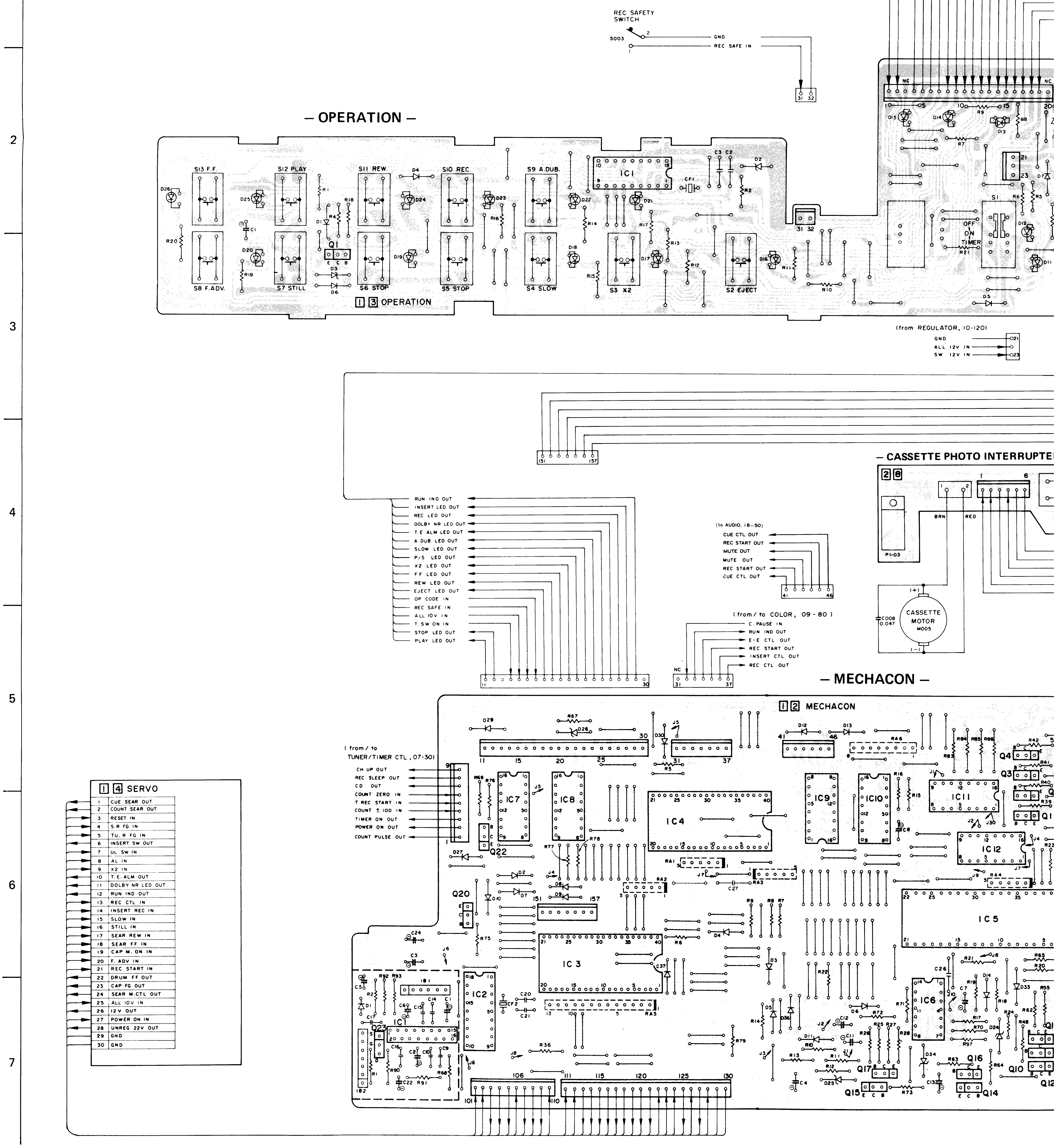
NOTES:
1. Voltages are DC-measured with a digital voltmeter during recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode is shown in parentheses.

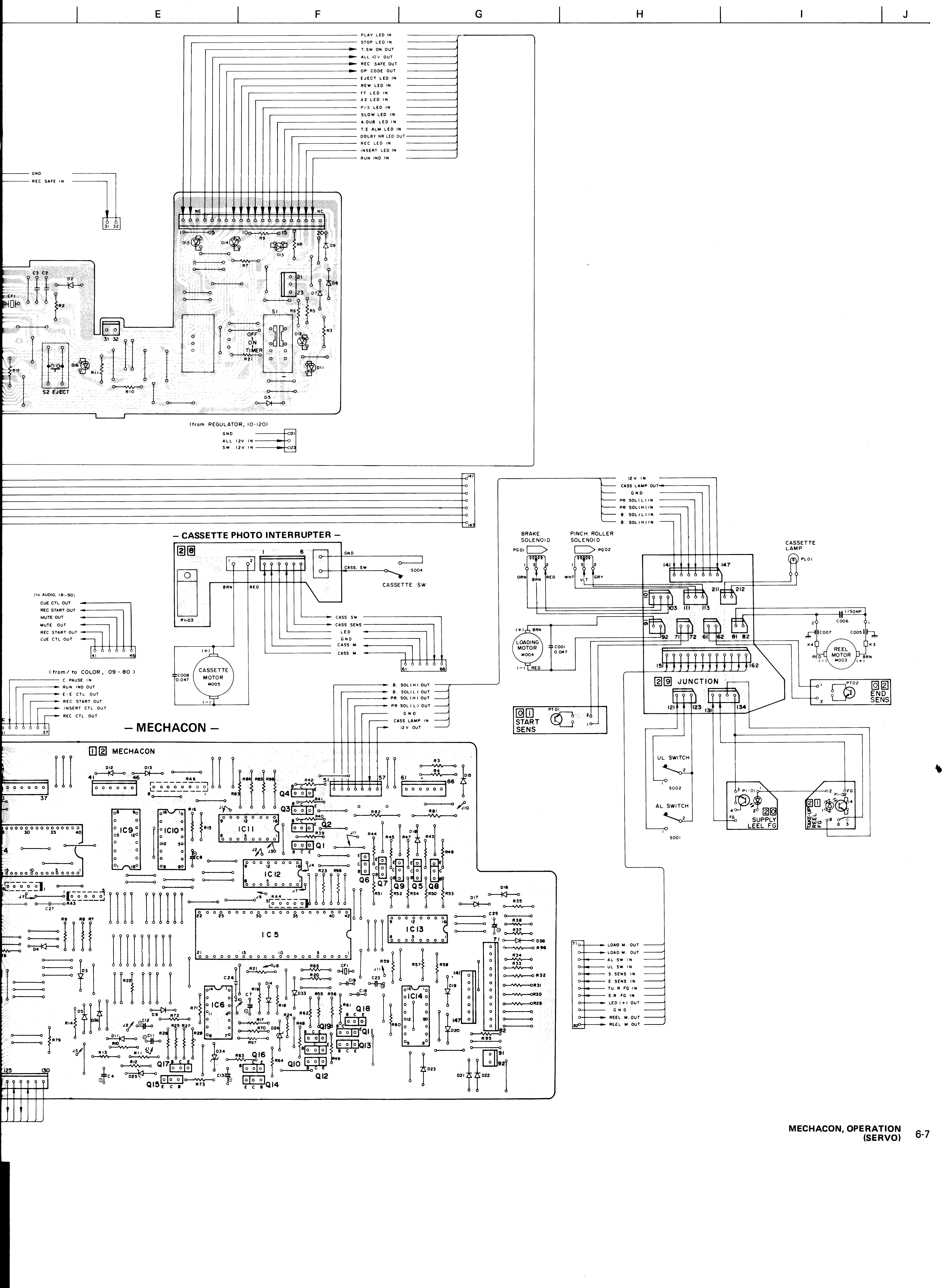
NOTE:
When not specified, waveform is recording ro E-E mode.


E
F
G
H
I
J
IC1-15
(OPERATION CODE)
8.5 Vp-p
91 Hz
(STOP KEY ON)
IC2-3
9 Vp-p
454.5 kHz
IC5-12
8.8 Vp-p
IC5-1
4.8 Vp-p
400 kHz
IC5-33
8.5 Vp-p
IC1 M51014L
INFRARED RECEIVER
OPERATION CODE
Q23 2SK34
IC2 M50127AP
SERIAL TO PARALLEL DECODER
Q20 2SD637
INPUT EXPANDER
IC3 M50786SP
IC4 M50786SP
OUTPUT EXPANDER
S.REEL FG AMP
OPERATION CODE DET
Q22 2SB641
IC5 UPD553C-210 or 185
CPU
Q1 ~ Q9 2SA1020
M54532P
IC6 UPC339C
RESET PULSE GENERATOR
IC6 UPC339C
T.U. REEL FG AMP
IC6 UPC339C
COMPARATOR
REEL MOTOR SPEED CONTROL
IC10 UPD4050C
IC10 UPD4050C
IC10 UPD4050C
DRUM MOTOR ON
JUNCTION
BRAKE SOLENOID
PG01
PINCH SOLENOID
PG02
CASSETTE LAMP
PL01
LOADING MOTOR (DC RESISTANCE 18 Ω)
M004
AFTER LOADING SW
S001
UNLOADING SW
S002
PT01
START SENSOR
PT02
END SENSOR
PT102
T.U. REEL FG
PT101
S. REEL FG
REEL MOTOR (DC RESISTANCE 16.9 Ω)
M003
CASSETTE PHOT INTRUPTER
CASSETTE MOTOR (DC RESISTANCE 18 Ω)
M005
S004
CASSETTE SW
WIRED REMOTE CONTROL UNIT
CH UP
REC
A.DUB
PLAY
PAUSE STILL
STOP
FF
REW
IC4-39
9.8 Vp-p
IC5-15
9.2 Vp-p
IC6-6
8.8 Vp-p
REMOTE STOP KEY ON
IC5-39
8.5 Vp-p
REMOTE STOP KEY ON

A
B
C
D
E
F
1
2
3
4
5
6
7

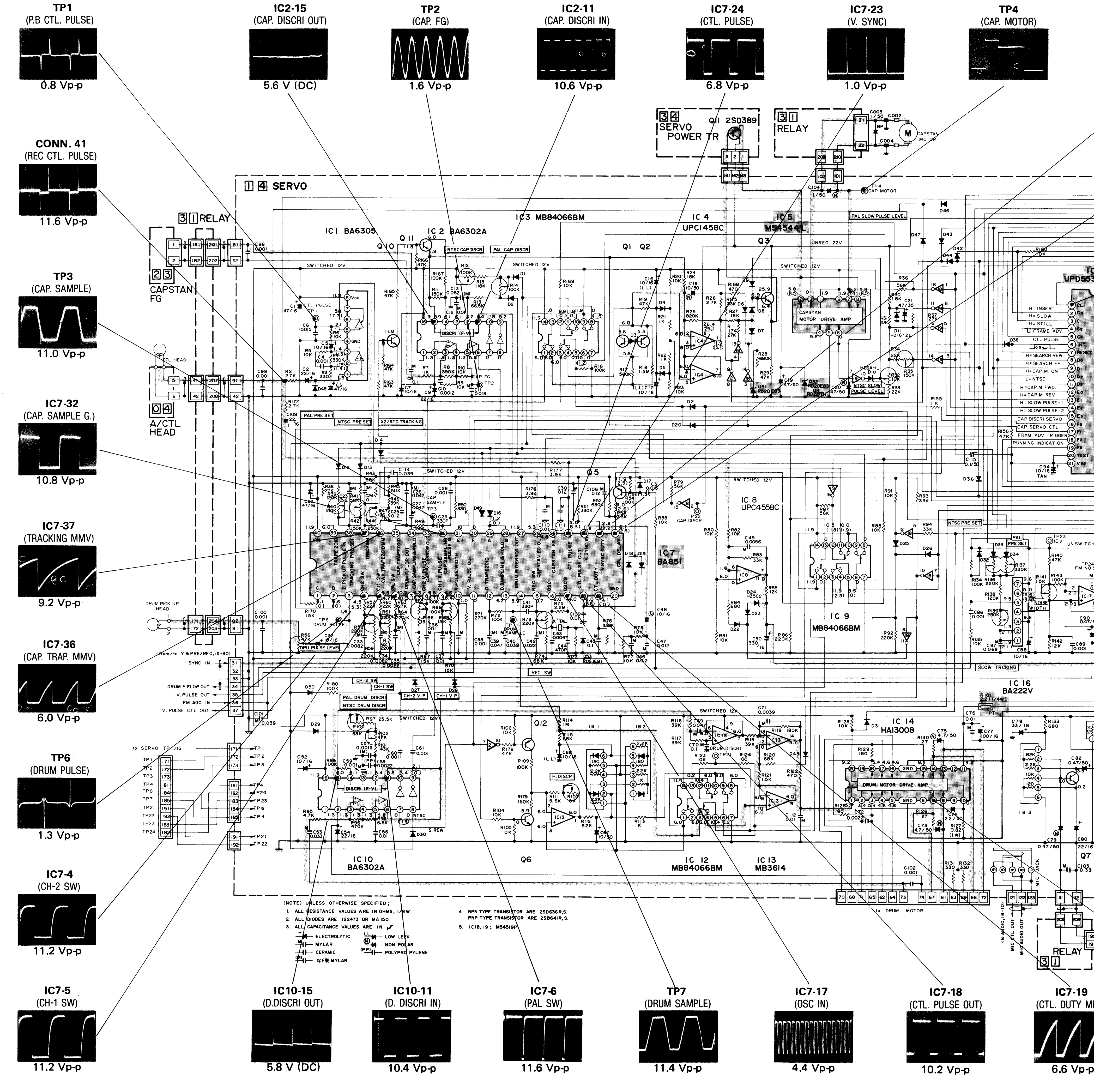
6 . 5 . 2 Circuit boards


REC SAFETY SWITCH
S003
GND
REC SAFE IN
31 32
– OPERATION –
S13 F.F.
S12 PLAY
S11 REW.
S10 REC.
S9 A.DUB.
IC1
S8 F.ADV.
S7 STILL
S6 STOP
S5 STOP
S4 SLOW
S3 X2
S2 EJECT
1 3 OPERATION
OFF
ON
TIMER
S1
(from REGULATOR, 10-120)
GND
ALL 12V IN
SW 12V IN
151
157
RUN IND OUT
INSERT LED OUT
REC LED OUT
DOLBY NR LED OUT
T.E ALM LED OUT
A.DUB LED OUT
SLOW LED OUT
P/S LED OUT
X2 LED OUT
FF LED OUT
REW LED OUT
EJECT LED OUT
OP CODE IN
REC SAFE IN
ALL 10V IN
T.SW ON IN
STOP LED OUT
PLAY LED OUT
11
30
(to AUDIO, 18–50)
CUE CTL OUT
REC START OUT
MUTE OUT
MUTE OUT
REC START OUT
CUE CTL OUT
41
46
(from/to COLOR, 09 - 80)
C.PAUSE IN
RUN IND OUT
E-E CTL OUT
REC START OUT
INSERT CTL OUT
REC CTL OUT
NC
31
37
– CASSETTE PHOTO INTERRUPTE
2 8
BRN
RED
P1-03
C008 0.047
CASSETTE MOTOR M005
– MECHACON –
1 2 MECHACON
(from/to TUNER/TIMER CTL, 07-30)
CH UP OUT
REC SLEEP OUT
CD OUT
COUNT ZERO IN
T.REC START IN
COUNT ± 100 IN
TIMER ON OUT
POWER ON OUT
COUNT PULSE OUT
IC7
IC8
IC4
IC9
IC10
IC11
IC12
IC3
IC5
IC2
IC6
IC1
Q20
Q22
Q23
1 4 SERVO
1 CUE SEAR OUT
2 COUNT SEAR OUT
3 RESET IN
4 S.R FG IN
5 TU. R FG IN
6 INSERT SW OUT
7 UL SW IN
8 AL IN
9 X2 IN
10 T.E. ALM OUT
11 DOLBY NR LED OUT
12 RUN IND OUT
13 REC CTL IN
14 INSERT REC IN
15 SLOW IN
16 STILL IN
17 SEAR REW IN
18 SEAR FF IN
19 CAP M. ON IN
20 F. ADV IN
21 REC START IN
22 DRUM FF OUT
23 CAP FG OUT
24 SEAR M.CTL OUT
25 ALL 10V IN
26 12V OUT
27 POWER ON IN
28 UNREG 22V OUT
29 GND
30 GND
101
106
110
111
115
120
125
130


E
F
G
H
I
J
PLAY LED IN
STOP LED IN
T.SW ON OUT
ALL 10V OUT
REC SAFE OUT
OP CODE OUT
EJECT LED IN
REW LED IN
FF LED IN
X2 LED IN
P/S LED IN
SLOW LED IN
A.DUB LED IN
T.E ALM LED IN
DOLBY NR LED OUT
REC LED IN
INSERT LED IN
RUN IND IN
GND
REC SAFE IN
S1
OFF
ON
TIMER
S2 EJECT
(from REGULATOR, 10-120)
GND
ALL 12V IN
SW 12V IN
– CASSETTE PHOTO INTERRUPTER –
28
CASS. SW
S004
CASSETTE SW
P1-03
BRN
RED
CASS SW
CASS SENS
LED
GND
CASS M.
CASS M.
CASSETTE MOTOR
M005
C008 0.047
(to AUDIO, 18-50)
CUE CTL OUT
REC START OUT
MUTE OUT
MUTE OUT
REC START OUT
CUE CTL OUT
(from/to COLOR, 09-80)
C.PAUSE IN
RUN IND OUT
E-E CTL OUT
REC START OUT
INSERT CTL OUT
REC CTL OUT
– MECHACON –
B. SOL(H) OUT
B. SOL(L) OUT
PR SOL(H) OUT
PR SOL(L) OUT
GND
CASS LAMP IN
12V OUT
12 MECHACON
IC5
IC6
IC9
IC10
IC11
IC12
IC13
IC14
12V IN
CASS LAMP OUT
GND
PR SOL(L) IN
PR SOL(H) IN
B. SOL(L) IN
B. SOL(H) IN
BRAKE SOLENOID
PG01
PINCH ROLLER SOLENOID
PG02
ORN
BRN
RED
WHT
VLT
GRY
CASSETTE LAMP
PL01
LOADING MOTOR
M004
C001 0.047
REEL MOTOR
M003
C006 1/50NP
C007
C005
29 JUNCTION
01 START SENS
PT01
02 END SENS
PT02
UL SWITCH
S002
AL SWITCH
S001
20 SUPPLY LEEL FG
P1-01
21 TAKE-UP REEL FG
P1-02
LOAD M. OUT
LOAD M. OUT
AL SW IN
UL SW IN
S.SENS IN
E.SENS IN
TU.R FG IN
S.R FG IN
LED(+) OUT
GND
REEL M.OUT
REEL M.OUT

6 . 6 SERVO CIRCUIT

6 . 6 . 1 Schematic diagram

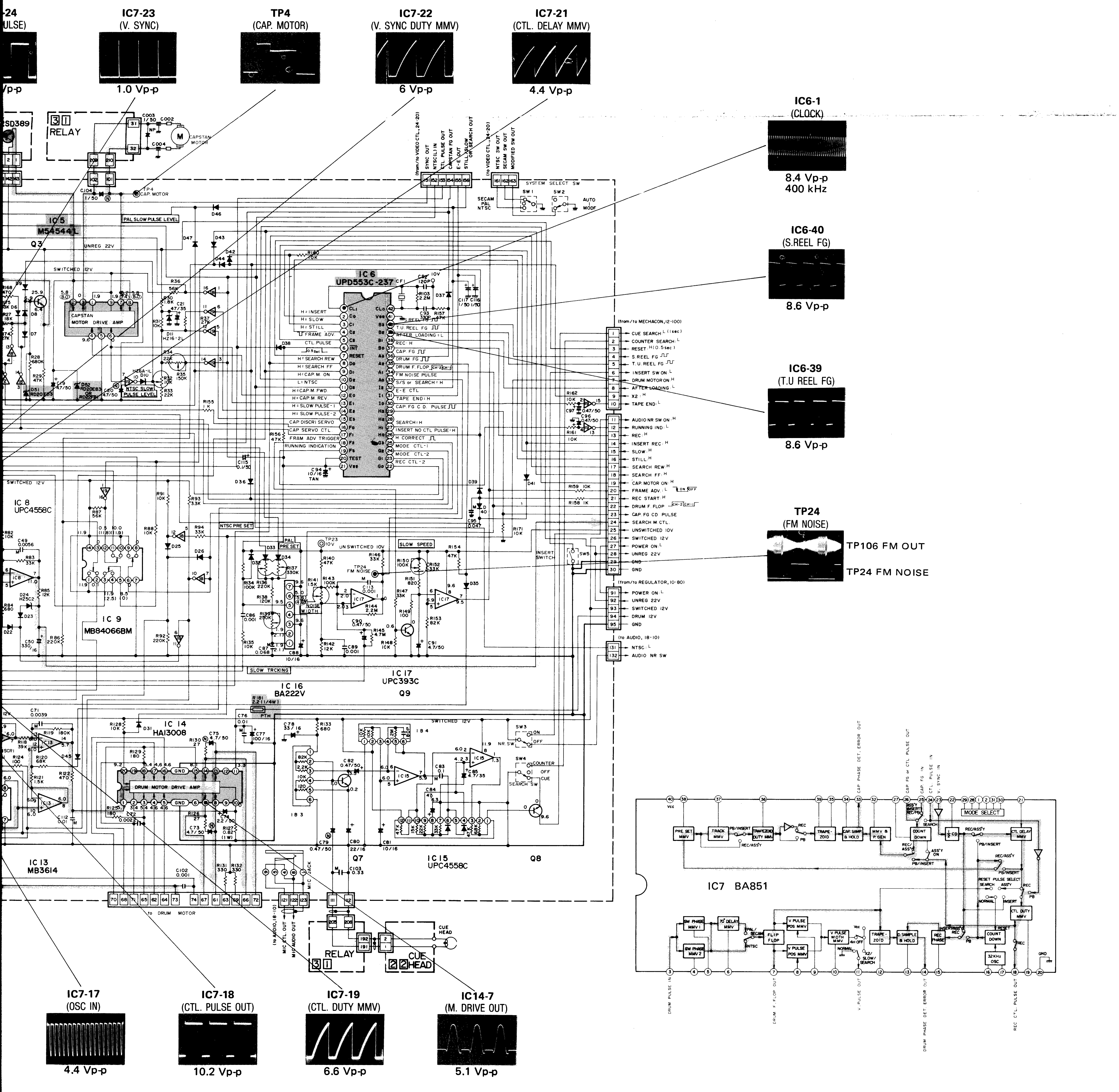

TP1 (P.B CTL. PULSE) 0.8 Vp-p
IC2-15 (CAP. DISCRI OUT) 5.6 V (DC)
TP2 (CAP. FG) 1.6 Vp-p
IC2-11 (CAP. DISCRI IN) 10.6 Vp-p
IC7-24 (CTL. PULSE) 6.8 Vp-p
IC7-23 (V. SYNC) 1.0 Vp-p
TP4 (CAP. MOTOR)
CONN. 41 (REC CTL. PULSE) 11.6 Vp-p
TP3 (CAP. SAMPLE) 11.0 Vp-p
IC7-32 (CAP. SAMPLE G.) 10.8 Vp-p
IC7-37 (TRACKING MMV) 9.2 Vp-p
IC7-36 (CAP. TRAP. MMV) 6.0 Vp-p
TP6 (DRUM PULSE) 1.3 Vp-p
IC7-4 (CH-2 SW) 11.2 Vp-p
IC7-5 (CH-1 SW) 11.2 Vp-p
IC10-15 (D.DISCRI OUT) 5.8 V (DC)
IC10-11 (D. DISCRI IN) 10.4 Vp-p
IC7-6 (PAL SW) 11.6 Vp-p
TP7 (DRUM SAMPLE) 11.4 Vp-p
IC7-17 (OSC IN) 4.4 Vp-p
IC7-18 (CTL. PULSE OUT) 10.2 Vp-p
IC7-19 (CTL. DUTY M
6.6 Vp-p
34 SERVO POWER TR
Q11 2SD389
31 RELAY
CAPSTAN MOTOR
14 SERVO
31 RELAY
23 CAPSTAN FG
04 A/CTL HEAD
CTL. HEAD
DRUM PICK UP HEAD
IC1 BA6305
IC 2 BA6302A
IC3 MB84066BM
IC 4 UPC1458C
IC 5 M54544L
Q1 Q2
Q3
Q10 Q11
CAPSTAN MOTOR DRIVE AMP
NTSC CAP DISCRI
PAL CAP DISCRI
PAL SLOW PULSE LEVEL
NTSC SLOW PULSE LEVEL
UNREG 22V
SWITCHED 12V
PAL PRE SET
NTSC PRE SET
X2/STD TRACKING
IC 7 BA851
Q5
IC 8 UPC4558C
IC 9 MB84066BM
IC 16 BA222V
IC 10 BA6302A
Q6
Q12
IC 12 MB84066BM
IC 13 MB3614
IC 14 HA13008
DRUM MOTOR DRIVE AMP
PAL DRUM DISCRI
NTSC DRUM DISCRI
CH-2 SW
CH-1 SW
CH-2 V.P
CH-1 V.P
REC SW
SLOW TRCKING
H.DISCRI
DISCRI (F-V)
UPD553
H=INSERT
H=SLOW
H=STILL
FRAME ADV
CTL PULSE
H=SEARCH REW
H=SEARCH FF
H=CAP M. ON
L=NTSC
H=CAP M. FWD
H=CAP M. REV
H=SLOW PULSE-1
H=SLOW PULSE-2
CAP DISCRI SERVO
CAP SERVO CTL
FRAM ADV TRIGGER
RUNNING INDICATION
to DRUM MOTOR
to SERVO TP JIG
SYNC IN
DRUM F.FLOP OUT
V. PULSE OUT
FM AGC IN
V. PULSE CTL OUT
(from/to Y B PRE/REC, 15-80)
RELAY 31
(NOTE) UNLESS OTHERWISE SPECIFIED;
1. ALL RESISTANCE VALUES ARE IN OHMS, 1/8W.
2. ALL DIODES ARE 1S2473 OR MA150.
3. ALL CAPACITANCE VALUES ARE IN μF
ELECTROLYTIC
MYLAR
CERAMIC
松下製 MYLAR
LOW LEEK
NON POLAR
POLYPRO PYLENE
4. NPN TYPE TRANSISTOR ARE 2SD636R,S.
PNP TYPE TRANSISTOR ARE 2SB641R,S.
5. IC18, 19 ; M54519P

NOTES:

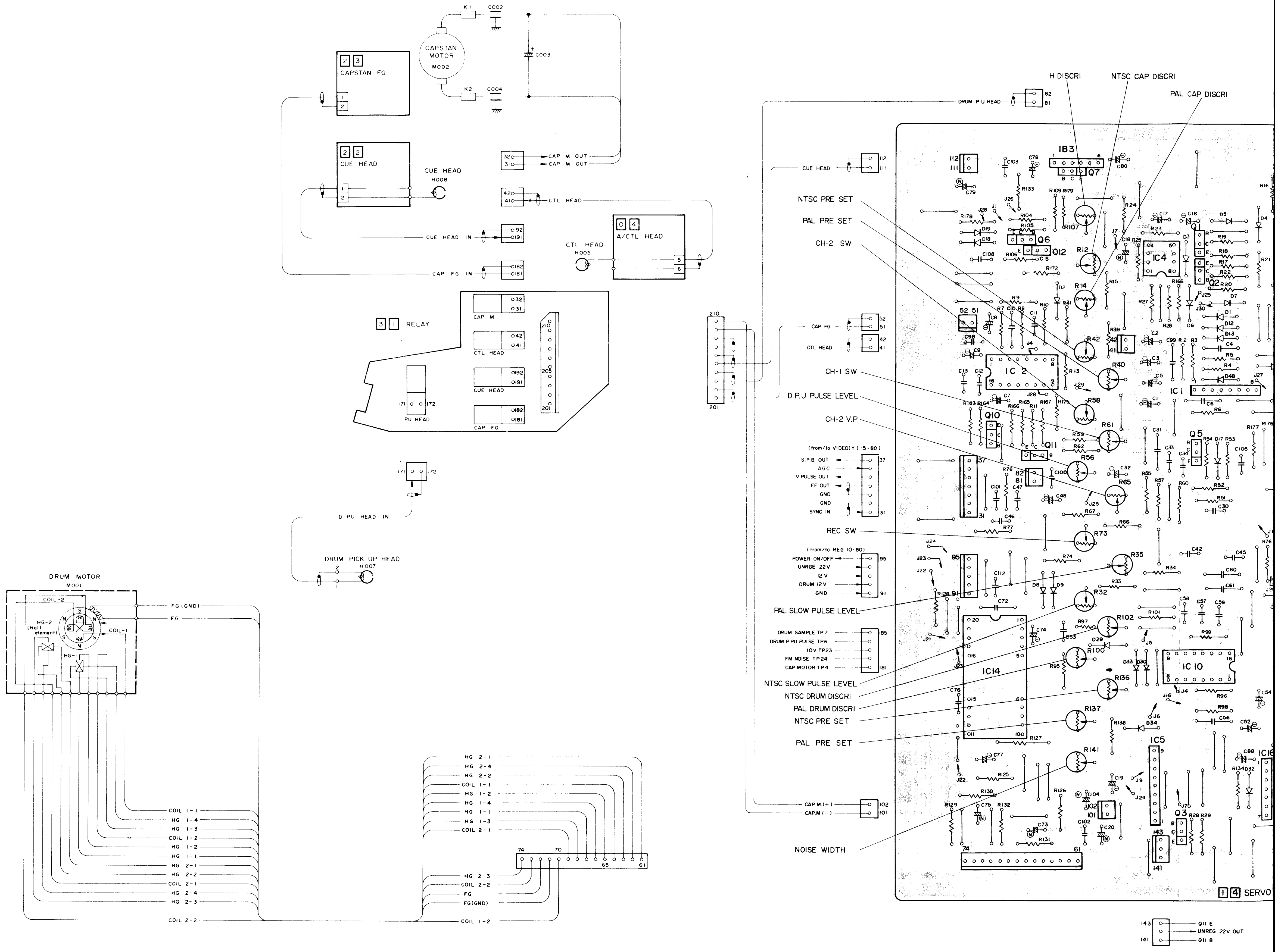
1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between PAL recording and PAL playback, the voltage during playback mode is shown in parentheses.

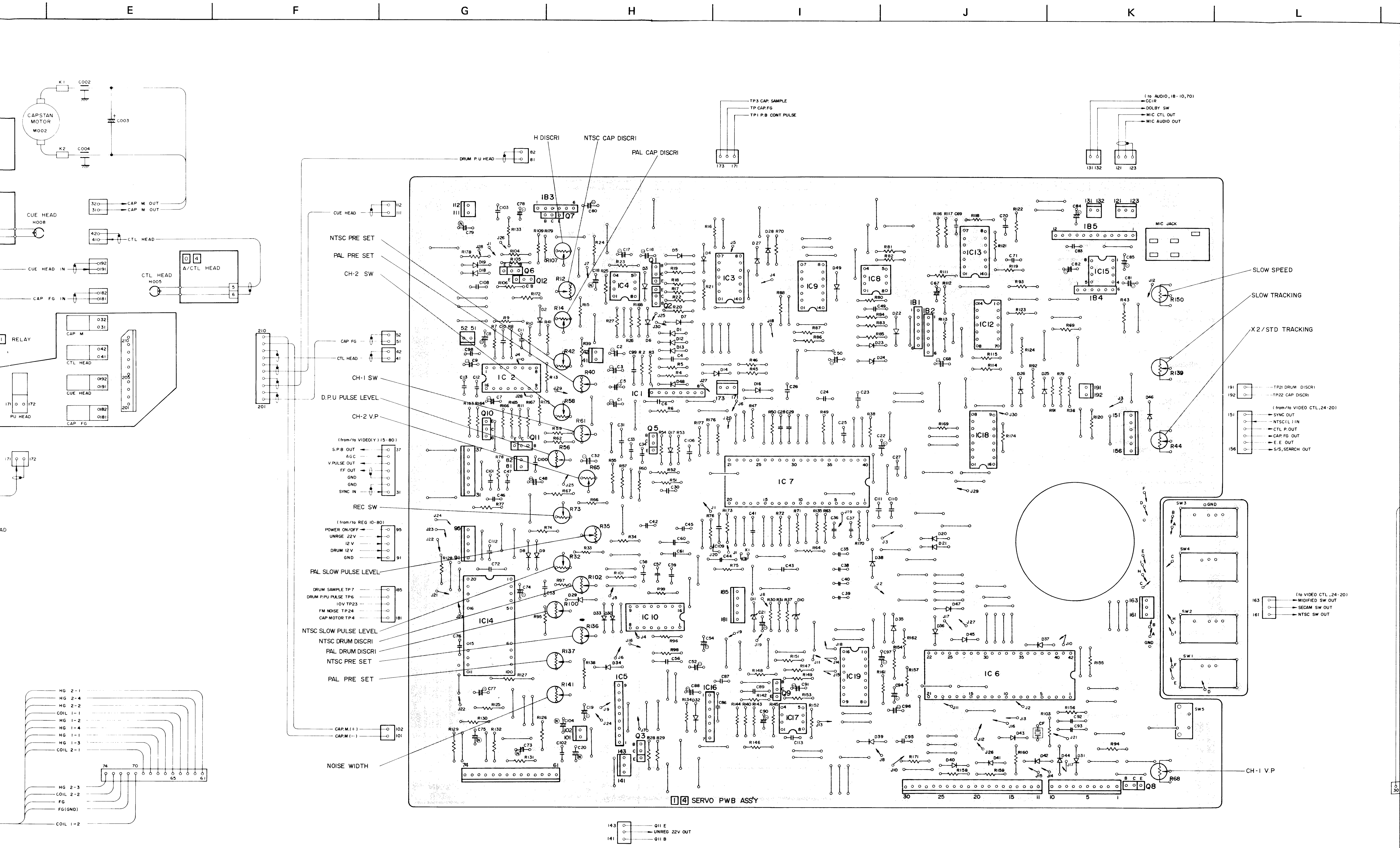
NOTE:

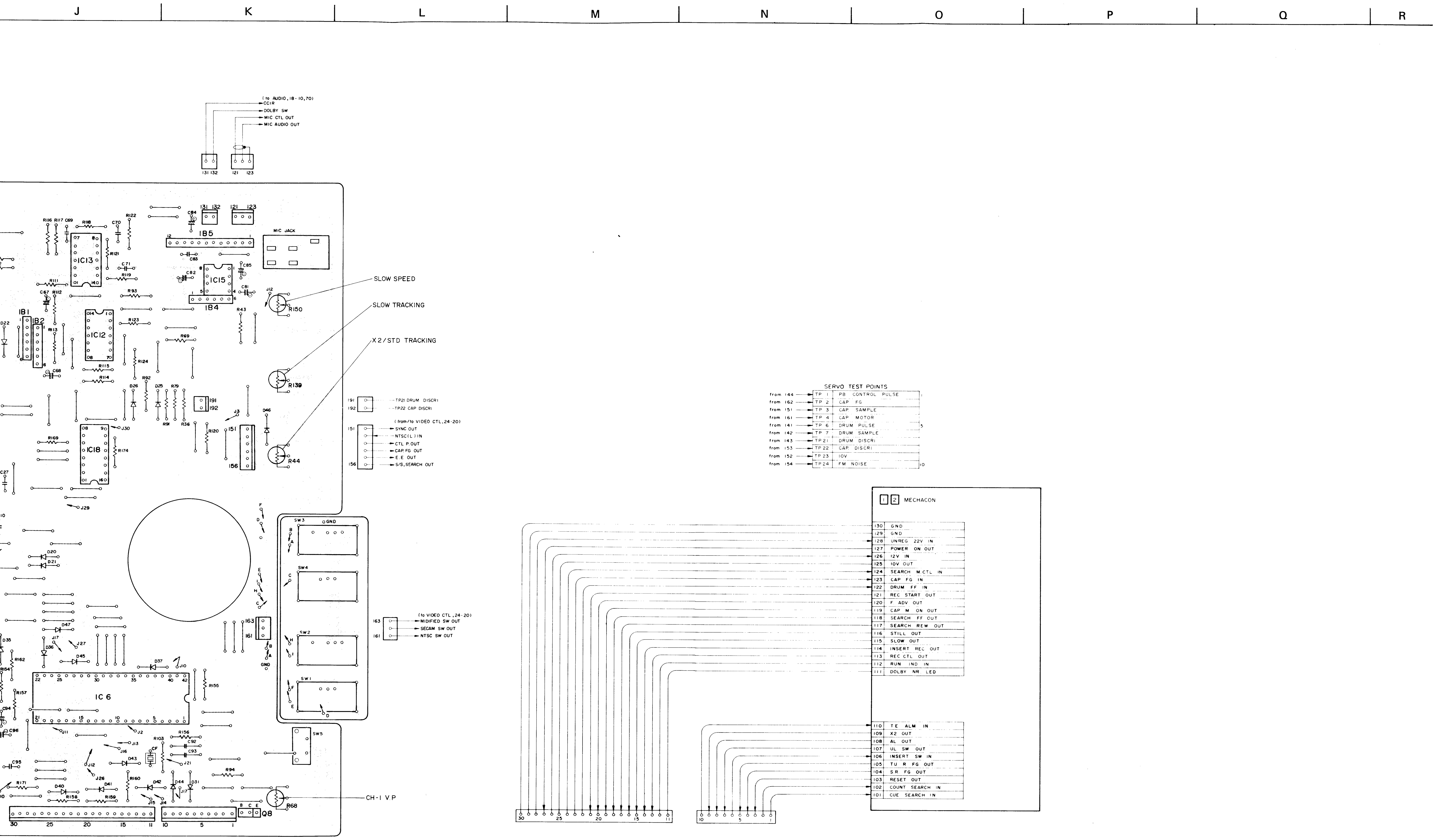
When not specified, waveform is PAL recording ro E-E mode.


IC7-23 (V. SYNC) 1.0 Vp-p
TP4 (CAP. MOTOR)
IC7-22 (V. SYNC DUTY MMV) 6 Vp-p
IC7-21 (CTL. DELAY MMV) 4.4 Vp-p
IC6-1 (CLOCK) 8.4 Vp-p 400 kHz
IC6-40 (S.REEL FG) 8.6 Vp-p
IC6-39 (T.U REEL FG) 8.6 Vp-p
TP24 (FM NOISE)
TP106 FM OUT
TP24 FM NOISE
IC7-17 (OSC IN) 4.4 Vp-p
IC7-18 (CTL. PULSE OUT) 10.2 Vp-p
IC7-19 (CTL. DUTY MMV) 6.6 Vp-p
IC14-7 (M. DRIVE OUT) 5.1 Vp-p
31 RELAY
IC5 M54544L
Q3
CAPSTAN MOTOR DRIVE AMP
IC6 UPD553C-237
IC8 UPC4558C
IC9 MB84066BM
IC13 MB3614
IC14 HA13008
DRUM MOTOR DRIVE AMP
IC16 BA222V
IC17 UPC393C
Q9
IC15 UPC4558C
Q7
Q8
SYSTEM SELECT SW
SECAM PAL NTSC
AUTO MODE
SLOW TRCKING
PAL PRE SET
NTSC PRE SET
SLOW SPEED
PAL SLOW PULSE LEVEL
NTSC SLOW PULSE LEVEL
INSERT SWITCH
MIC JACK
to DRUM MOTOR
RELAY 31
CUE HEAD 22
(from/to MECHACON, 12-100)
(from/to REGULATOR, 10-80)
(to AUDIO, 18-10)
IC7 BA851
PRE SET MMV
TRACK MMV
TRAPEZOID DUTY MMV
TRAPEZOID
CAP SAMP & HOLD
MMV & P.GEN
COUNT DOWN
CTL DELAY MMV
CTL DUTY MMV
MODE SELECT
SW PHASE MMV 1
SW PHASE MMV 2
70° DELAY MMV
FLIP FLOP
V PULSE POS MMV
V PULSE WIDTH MMV
D SAMPLE & HOLD
REC PHASE
32KHz OSC
DRUM PULSE IN
DRUM F. FLOP OUT
V. PULSE OUT
DRUM PHASE DET. ERROR OUT
REC CTL. PULSE OUT
CAP PHASE DET. ERROR OUT
CAP FG or CTL PULSE OUT
CAP FG IN
CTL PULSE IN
V. SYNC IN

6.6.2 Circuit boards

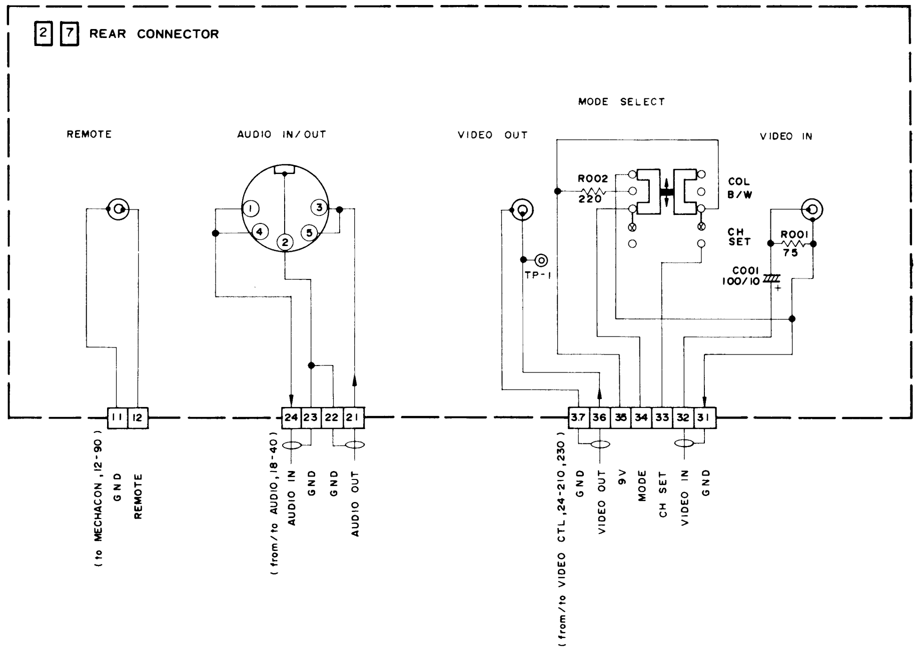

A
B
C
D
E
F
G
H
1
2
3
4
5
6
CAPSTAN MOTOR M002
K1
K2
C002
C003
C004
2 3 CAPSTAN FG
2 2 CUE HEAD
CUE HEAD H008
CAP M OUT
CTL HEAD
CUE HEAD IN
CAP FG IN
0 4 A/CTL HEAD
CTL HEAD H005
3 1 RELAY
CAP M
CTL HEAD
CUE HEAD
CAP FG
PU HEAD
D PU HEAD IN
DRUM PICK UP HEAD H007
DRUM MOTOR M001
COIL-2
COIL-1
HG-2 (Hall element)
HG-1
FG (GND)
FG
COIL 1-1
HG 1-4
HG 1-3
COIL 1-2
HG 1-2
HG 1-1
HG 2-1
HG 2-2
COIL 2-1
HG 2-4
HG 2-3
COIL 2-2
HG 2-1
HG 2-4
HG 2-2
COIL 1-1
HG 1-2
HG 1-4
HG 1-1
HG 1-3
COIL 2-1
HG 2-3
COIL 2-2
FG
FG(GND)
COIL 1-2
DRUM P.U HEAD
H DISCRI
NTSC CAP DISCRI
PAL CAP DISCRI
CUE HEAD
NTSC PRE SET
PAL PRE SET
CH-2 SW
CAP FG
CTL HEAD
CH-1 SW
D.P.U PULSE LEVEL
CH-2 V.P
(from/to VIDEO(Y) 15-80)
S.P.B OUT
AGC
V.PULSE OUT
FF OUT
GND
GND
SYNC IN
REC SW
(from/to REG 10-80)
POWER ON/OFF
UNRGE 22V
12V
DRUM 12V
GND
PAL SLOW PULSE LEVEL
DRUM SAMPLE TP7
DRUM P.PU PULSE TP6
10V TP23
FM NOISE TP24
CAP MOTOR TP4
NTSC SLOW PULSE LEVEL
NTSC DRUM DISCRI
PAL DRUM DISCRI
NTSC PRE SET
PAL PRE SET
NOISE WIDTH
CAP.M.(+)
CAP.M.(−)
IC1
IC2
IC4
IC5
IC10
IC14
Q2
Q3
Q5
Q6
Q7
Q10
Q11
Q12
R12
R14
R32
R35
R40
R42
R56
R58
R61
R65
R73
R100
R102
R107
R136
R137
R141
1 4 SERVO
Q11 E
UNREG 22V OUT
Q11 B


E
F
G
H
I
J
K
L
CAPSTAN MOTOR M002
K1
K2
C002
C003
C004
CAP M. OUT
CAP M. OUT
CUE HEAD H008
CTL HEAD
CUE HEAD IN
CAP FG IN
CTL HEAD H005
A/CTL HEAD
RELAY
CAP M
CTL HEAD
CUE HEAD
CAP FG
PU HEAD
DRUM P.U HEAD
CUE HEAD
CAP FG
CTL HEAD
H DISCRI
NTSC CAP DISCRI
PAL CAP DISCRI
TP3 CAP. SAMPLE
TP CAP.FG
TP1 P.B CONT PULSE
(to AUDIO, 18-10,70)
CCIR
DOLBY SW
MIC CTL OUT
MIC AUDIO OUT
MIC JACK
NTSC PRE SET
PAL PRE SET
CH-2 SW
CH-1 SW
D.P.U PULSE LEVEL
CH-2 V.P
(from/to VIDEO(Y) 15-80)
S.P.B OUT
AGC
V.PULSE OUT
F.F OUT
GND
GND
SYNC IN
REC SW
(from/to REG 10-80)
POWER ON/OFF
UNRGE 22V
12 V
DRUM 12 V
GND
PAL SLOW PULSE LEVEL
DRUM SAMPLE TP7
DRUM P.PU PULSE TP6
10V TP23
FM NOISE TP24
CAP MOTOR TP4
NTSC SLOW PULSE LEVEL
NTSC DRUM DISCRI
PAL DRUM DISCRI
NTSC PRE SET
PAL PRE SET
NOISE WIDTH
HG 2-1
HG 2-4
HG 2-2
COIL 1-1
HG 1-2
HG 1-4
HG 1-1
HG 1-3
COIL 2-1
HG 2-3
COIL 2-2
FG
FG(GND)
COIL 1-2
CAP.M.(+)
CAP.M.(-)
IC 1
IC 2
IC3
IC4
IC 5
IC 6
IC 7
IC8
IC9
IC 10
IC12
IC13
IC14
IC15
IC16
IC17
IC18
IC19
SLOW SPEED
SLOW TRACKING
X2/STD TRACKING
TP21 DRUM DISCRI
TP22 CAP DISCRI
(from/to VIDEO CTL, 24-20)
SYNC OUT
NTSC(L) IN
CTL P.OUT
CAP.FG OUT
E.E OUT
S/S, SEARCH OUT
SW3
SW4
SW2
SW1
SW5
GND
(to VIDEO CTL, 24-20)
MODIFIED SW OUT
SECAM SW OUT
NTSC SW OUT
CH-1 V P
1 4 SERVO PWB ASS'Y
Q11 E
UNREG 22V OUT
Q11 B

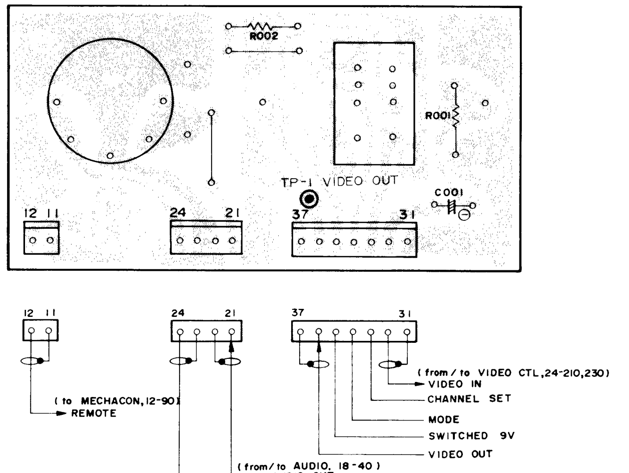

J
K
L
M
N
O
P
Q
R
(to AUDIO,18-10,70)
CCIR
DOLBY SW
MIC CTL OUT
MIC AUDIO OUT
131 132
121 123
MIC JACK
IB5
IB4
IB1
IB2
IC13
IC12
IC15
IC18
IC 6
SLOW SPEED
SLOW TRACKING
X2/STD TRACKING
R150
R139
R44
R68
CH-1 V.P
Q8
SW1
SW2
SW3
SW4
SW5
GND
191 192
TP21 DRUM DISCRI
TP22 CAP DISCRI
(from/to VIDEO CTL,24-20)
151
SYNC OUT
NTSC(L) IN
CTL P.OUT
CAP.FG OUT
E.E OUT
156
S/S,SEARCH OUT
(to VIDEO CTL,24-20)
163
MIDIFIED SW OUT
SECAM SW OUT
161
NTSC SW OUT
SERVO TEST POINTS
from 144 TP 1 PB CONTROL PULSE
from 162 TP 2 CAP FG
from 151 TP 3 CAP. SAMPLE
from 161 TP 4 CAP MOTOR
from 141 TP 6 DRUM PULSE
from 142 TP 7 DRUM SAMPLE
from 143 TP 21 DRUM DISCRI
from 153 TP 22 CAP. DISCRI
from 152 TP 23 10V
from 154 TP 24 FM NOISE
1
5
10
1 2 MECHACON
130 GND
129 GND
128 UNREG 22V IN
127 POWER ON OUT
126 12V IN
125 10V OUT
124 SEARCH M.CTL IN
123 CAP FG IN
122 DRUM FF IN
121 REC START OUT
120 F. ADV OUT
119 CAP M ON OUT
118 SEARCH FF OUT
117 SEARCH REW OUT
116 STILL OUT
115 SLOW OUT
114 INSERT REC OUT
113 REC CTL OUT
112 RUN IND IN
111 DOLBY NR. LED
110 TE ALM IN
109 X2 OUT
108 AL OUT
107 UL SW OUT
106 INSERT SW IN
105 TU R FG OUT
104 S.R. FG OUT
103 RESET OUT
102 COUNT SEARCH IN
101 CUE SEARCH IN
30
25
20
15
11
10
5
1

6.7 REAR CONNECTOR CIRCUIT

6.7.1 Schematic diagram

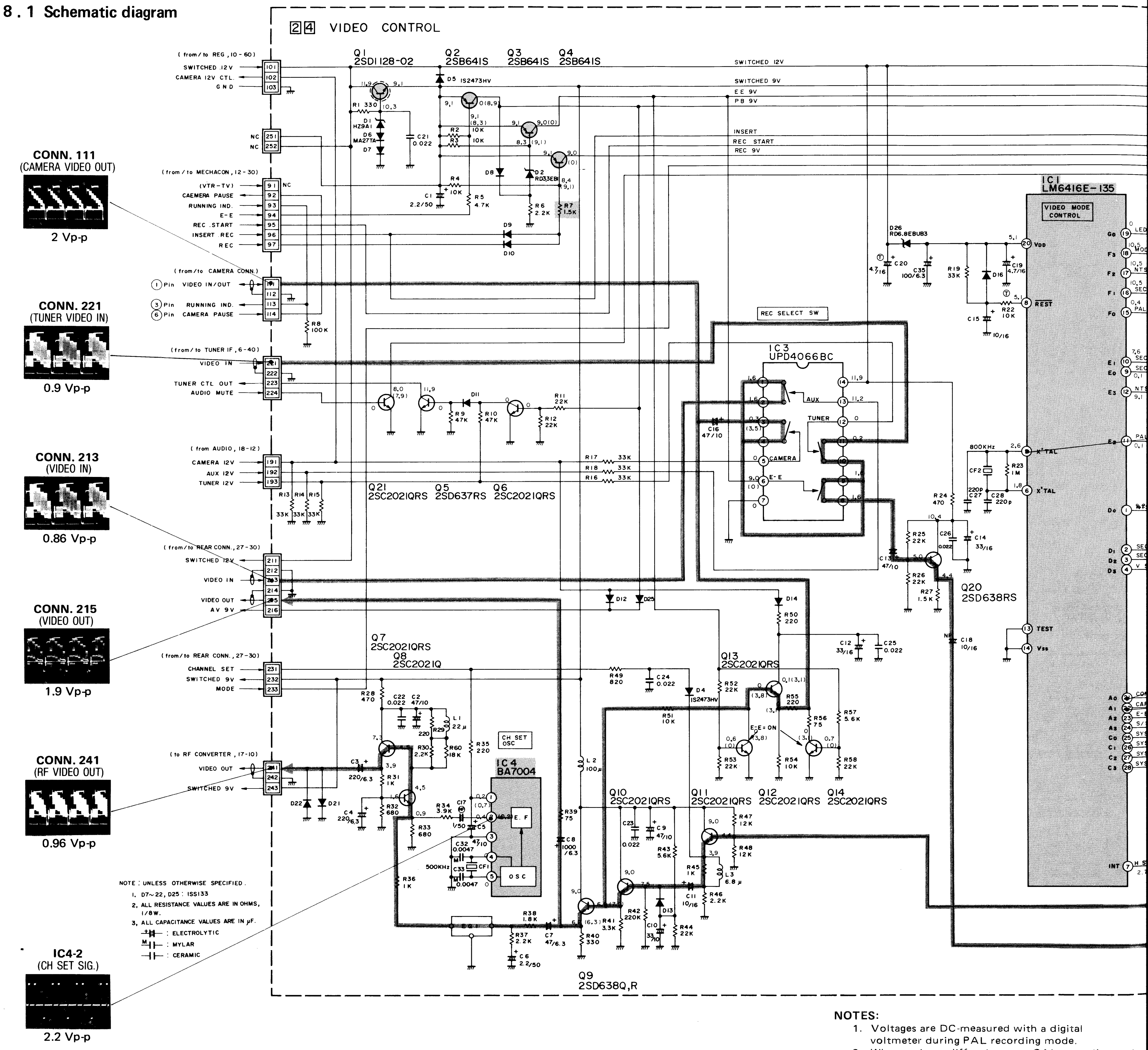

2 7 REAR CONNECTOR
REMOTE
AUDIO IN/OUT
VIDEO OUT
MODE SELECT
VIDEO IN
R002 220
COL B/W
CH SET
R001 75
C001 100/10
TP-1
11 12
24 23 22 21
37 36 35 34 33 32 31
(to MECHACON, 12-90)
GND
REMOTE
(from/to AUDIO, 18-40)
AUDIO IN
GND
GND
AUDIO OUT
(from/to VIDEO CTL, 24-210, 230)
GND
VIDEO OUT
9V
MODE
CH SET
VIDEO IN
GND

6.7.2 Circuit board


R002
R001
TP-1 VIDEO OUT
C001
12 11
24 21
37 31
(from/to VIDEO CTL, 24-210, 230)
VIDEO IN
CHANNEL SET
MODE
SWITCHED 9V
VIDEO OUT
(to MECHACON, 12-90)
REMOTE
(from/to AUDIO, 18-40)
AUDIO OUT
AUDIO IN

6.8 VIDEO CONTROL CIRCUIT

6.8.1 Schematic diagram


2 4 VIDEO CONTROL
CONN. 111
(CAMERA VIDEO OUT)
2 Vp-p
CONN. 221
(TUNER VIDEO IN)
0.9 Vp-p
CONN. 213
(VIDEO IN)
0.86 Vp-p
CONN. 215
(VIDEO OUT)
1.9 Vp-p
CONN. 241
(RF VIDEO OUT)
0.96 Vp-p
IC4-2
(CH SET SIG.)
2.2 Vp-p
(from/to REG, 10-60)
SWITCHED 12V
CAMERA 12V CTL.
GND
NC
NC
(from/to MECHACON, 12-30)
(VTR-TV)
CAEMERA PAUSE
RUNNING IND.
E-E
REC START
INSERT REC
REC
(from/to CAMERA CONN.)
① Pin VIDEO IN/OUT
③ Pin RUNNING IND.
⑥ Pin CAMERA PAUSE
(from/to TUNER IF, 6-40)
VIDEO IN
TUNER CTL OUT
AUDIO MUTE
(from AUDIO, 18-12)
CAMERA 12V
AUX 12V
TUNER 12V
(from/to REAR CONN., 27-30)
SWITCHED 12V
VIDEO IN
VIDEO OUT
AV 9V
(from/to REAR CONN., 27-30)
CHANNEL SET
SWITCHED 9V
MODE
(to RF CONVERTER, 17-10)
VIDEO OUT
SWITCHED 9V
Q1 2SD1128-02
Q2 2SB641S
Q3 2SB641S
Q4 2SB641S
Q21 2SC2021QRS
Q5 2SD637RS
Q6 2SC2021QRS
Q7 2SC2021QRS
Q8 2SC2021Q
Q9 2SD638Q,R
Q10 2SC2021QRS
Q11 2SC2021QRS
Q12 2SC2021QRS
Q13 2SC2021QRS
Q14 2SC2021QRS
Q20 2SD638RS
IC1 LM6416E-135
VIDEO MODE CONTROL
IC3 UPD4066BC
AUX
TUNER
CAMERA
E-E
REC SELECT SW
IC4 BA7004
CH SET OSC
E.F
OSC
500KHz
800KHz
SWITCHED 12V
SWITCHED 9V
EE 9V
PB 9V
INSERT
REC START
REC 9V
VDD
REST
X'TAL
TEST
Vss
INT
D5 1S2473HV
D1 HZ9A1
D6 MA27TA
D2 RD33EB
D26 RD6.8EBUB3
D4 1S2473HV
E-E=ON

NOTE: UNLESS OTHERWISE SPECIFIED.

1. D7～22, D25: 1SS133
2. ALL RESISTANCE VALUES ARE IN OHMS, 1/8W.
3. ALL CAPACITANCE VALUES ARE IN μF.
   - ⊣⊢ + : ELECTROLYTIC
   - M ⊣⊢ : MYLAR
   - ⊣⊢ : CERAMIC

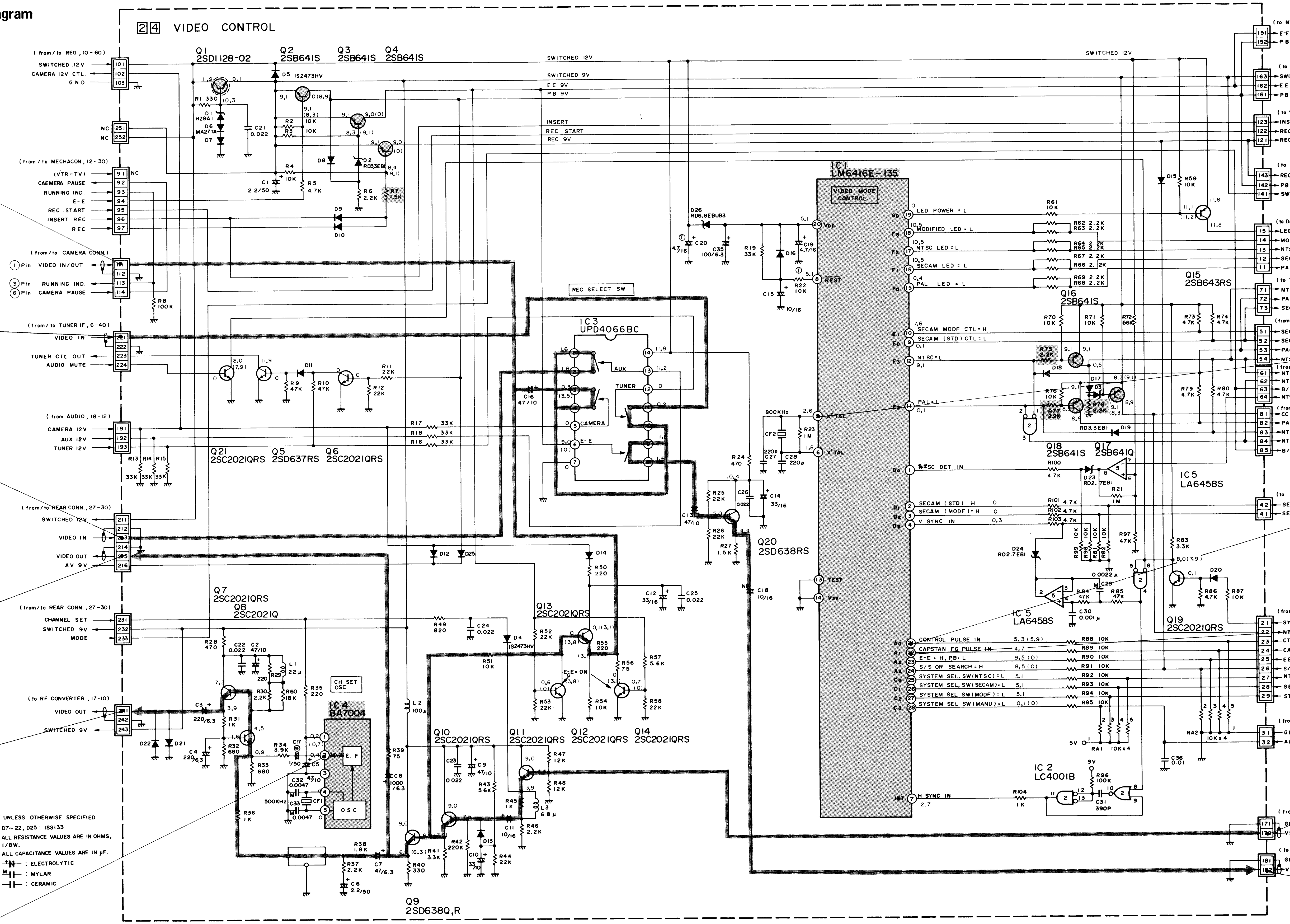
NOTES:

1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between PAL recording and PAL playback, the voltage during playback mode is shown in parentheses.

CIRCUIT

gram

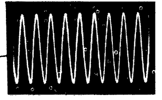
6.8.2 Circui


24 VIDEO CONTROL
Q1 2SD1128-02
Q2 2SB641S
Q3 2SB641S
Q4 2SB641S
SWITCHED 12V
SWITCHED 9V
EE 9V
PB 9V
INSERT
REC START
REC 9V
(from/to REG, 10-60)
SWITCHED 12V
CAMERA 12V CTL.
GND
(from/to MECHACON, 12-30)
(VTR-TV)
CAMERA PAUSE
RUNNING IND.
E-E
REC START
INSERT REC
REC
(from/to CAMERA CONN.)
① Pin VIDEO IN/OUT
③ Pin RUNNING IND.
⑥ Pin CAMERA PAUSE
(from/to TUNER IF, 6-40)
VIDEO IN
TUNER CTL OUT
AUDIO MUTE
(from AUDIO, 18-12)
CAMERA 12V
AUX 12V
TUNER 12V
(from/to REAR CONN., 27-30)
SWITCHED 12V
VIDEO IN
VIDEO OUT
AV 9V
(from/to REAR CONN., 27-30)
CHANNEL SET
SWITCHED 9V
MODE
(to RF CONVERTER, 17-10)
VIDEO OUT
SWITCHED 9V
REC SELECT SW
IC3 UPD4066BC
AUX
TUNER
CAMERA
E-E
Q21 2SC2021QRS
Q5 2SD637RS
Q6 2SC2021QRS
Q7 2SC2021QRS
Q8 2SC2021Q
IC4 BA7004
CH SET OSC
E.F
OSC
500KHz
Q9 2SD638Q,R
Q10 2SC2021QRS
Q11 2SC2021QRS
Q12 2SC2021QRS
Q13 2SC2021QRS
Q14 2SC2021QRS
Q20 2SD638RS
IC1 LM6416E-135
VIDEO MODE CONTROL
800KHz
LED POWER = L
MODIFIED LED = L
NTSC LED = L
SECAM LED = L
PAL LED = L
SECAM MODF CTL = H
SECAM (STD) CTL = L
NTSC = L
PAL = L
X'TAL
F.SC DET IN
SECAM (STD) H
SECAM (MODF) = H
V SYNC IN
TEST
VSS
VDD
REST
CONTROL PULSE IN
CAPSTAN FG PULSE IN
E-E : H, PB : L
S/S OR SEARCH = H
SYSTEM SEL. SW (NTSC) = L
SYSTEM SEL. SW (SECAM) = L
SYSTEM SEL SW (MODF) = L
SYSTEM SEL SW (MANU) = L
H SYNC IN
INT
Q15 2SB643RS
Q16 2SB641S
Q17 2SB641Q
Q18 2SB641S
Q19 2SC2021QRS
IC5 LA6458S
IC2 LC4001B
(to NTSC COLOR, 11-50)
E-E 9V
PB 9V
(to CHROMA AMP, 25-20)
SWITCHED 9V
EE 9V
PB 9V
(to VIDEO SUB 15-12)
INSERT REC
REC START
REC 9V
(to VIDEO SUB, 33-20)
REC 9V
PB 9V
SWITCHED 9V
(to DISPLAY, 08-60)
LED POWER (H)
MODIFIED LED (L)
NTSC LED (L)
SECAM LED (L)
PAL LED (L)
(to VIDEO SUB 33-30)
NTSC 9V
PAL or SECAM MODF CTL (H)
SECAM STD CTL (H)
(from/to CHROMA AMP, 25-20)
SECAM MODF CTL (L)
SECAM STD CTL (H)
PAL or SECAM MODF CTL (H)
NTSC 9V
(from/to NTSC COLOR, 11-60)
NTSC 9V
NTSC 4.43 CTL (H)
B/W CTL (H)
NTSC DET.
3.58-5V
3.58-6V
(from to COLOR, 09-15)
CCIR 9V
PAL 9V
NTSC 3.58 CTL (H)
NTSC 4.43 CTL (H)
B/W CTL (H)
(to COLOR, 09-17)
SECAM DET (SECAM (STD) ---- H)
SECAM MODF DET (SECAM MODF ---- H)
(from/to SERVO, 14-15)
SYNC
NTSC (L)
CTL PULSE
CAP FG
EE (H)
S/S OR SEARCH (H)
NTSC (L) SW
SECAM (L) SW
STD/MODF (L) SW
(from INPUT SW, 26-10)
GND
AUTO (H)/MAN (L) SW
(from VIDEO SUB, 33-50)
GND
VIDEO IN
(to NTSC COLOR, 11-70)
GND
VIDEO OUT

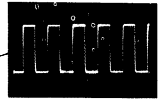
UNLESS OTHERWISE SPECIFIED.
D7~22, D25 : 1SS133
ALL RESISTANCE VALUES ARE IN OHMS, 1/8W.
ALL CAPACITANCE VALUES ARE IN µF.
: ELECTROLYTIC
: MYLAR
: CERAMIC

(to COLOR BOARD,
PB 9V OUT
E-E 9V OUT
SWITCHED 9V OUT

IC1-5
(X'TAL OSC)

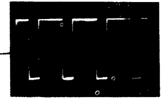


IC1-21
(CTL. PULSE)



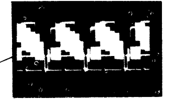
6.4 Vp-p

IC1-22
(CAP. FG)



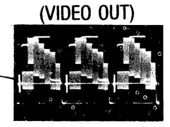
7.2 Vp-p

CONN. 172
(VIDEO IN)



2.0 Vp-p

CONN. 182
(VIDEO OUT)



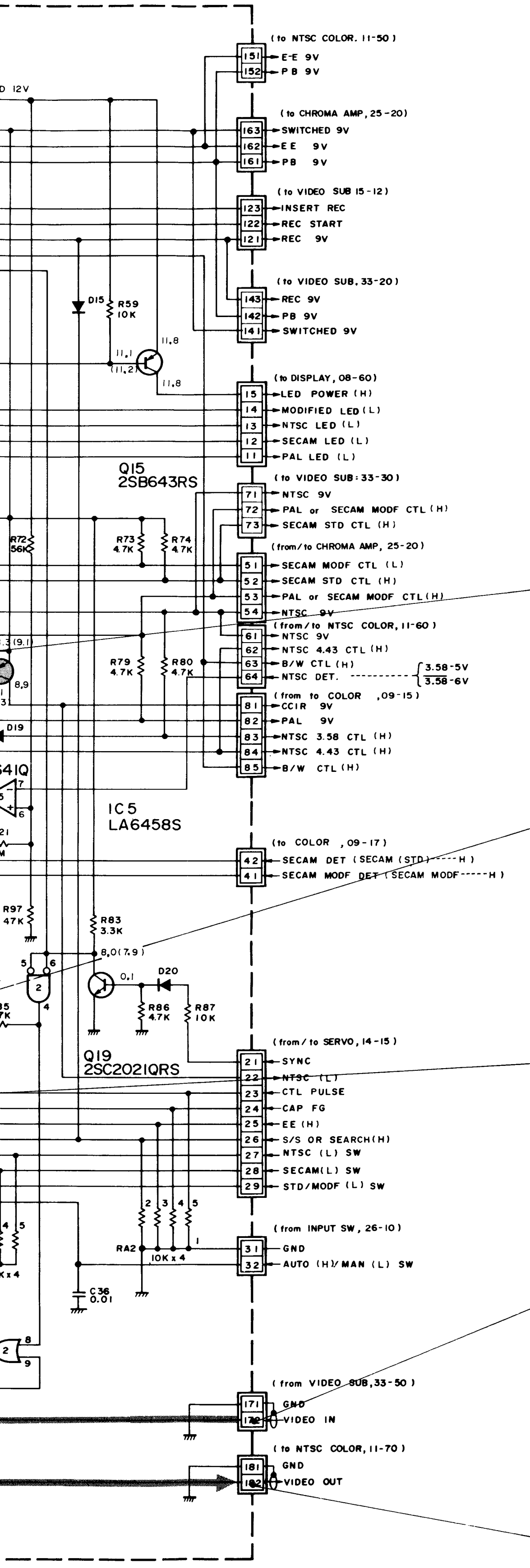
0.94 Vp-p

NOTES:

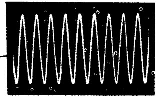
1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between PAL recording and PAL playback, the voltage during playback mode is shown in parentheses.

NOTE:

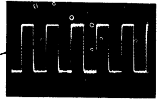
When not specified, waveform is PAL recording ro E-E mode.


(to NTSC COLOR, 11-50)
151 E-E 9V
152 PB 9V
(to CHROMA AMP, 25-20)
163 SWITCHED 9V
162 EE 9V
161 PB 9V
(to VIDEO SUB 15-12)
123 INSERT REC
122 REC START
121 REC 9V
(to VIDEO SUB, 33-20)
143 REC 9V
142 PB 9V
141 SWITCHED 9V
(to DISPLAY, 08-60)
15 LED POWER (H)
14 MODIFIED LED (L)
13 NTSC LED (L)
12 SECAM LED (L)
11 PAL LED (L)
(to VIDEO SUB : 33-30)
71 NTSC 9V
72 PAL or SECAM MODF CTL (H)
73 SECAM STD CTL (H)
(from/to CHROMA AMP, 25-20)
51 SECAM MODF CTL (L)
52 SECAM STD CTL (H)
53 PAL or SECAM MODF CTL (H)
54 NTSC 9V
(from/to NTSC COLOR, 11-60)
61 NTSC 9V
62 NTSC 4.43 CTL (H)
63 B/W CTL (H)
64 NTSC DET. 3.58-5V 3.58-6V
(from to COLOR ,09-15)
81 CCIR 9V
82 PAL 9V
83 NTSC 3.58 CTL (H)
84 NTSC 4.43 CTL (H)
85 B/W CTL (H)
(to COLOR ,09-17)
42 SECAM DET (SECAM (STD) H)
41 SECAM MODF DET (SECAM MODF H)
(from/to SERVO, 14-15)
21 SYNC
22 NTSC (L)
23 CTL PULSE
24 CAP FG
25 EE (H)
26 S/S OR SEARCH(H)
27 NTSC (L) SW
28 SECAM(L) SW
29 STD/MODF (L) SW
(from INPUT SW, 26-10)
31 GND
32 AUTO (H)/MAN (L) SW
(from VIDEO SUB,33-50)
171 GND
172 VIDEO IN
(to NTSC COLOR, 11-70)
181 GND
182 VIDEO OUT
Q15 2SB643RS
IC5 LA6458S
Q19 2SC2021QRS
D15 R59 10K
R72 56K
R73 4.7K R74 4.7K
R79 4.7K R80 4.7K
R83 3.3K
R86 4.7K R87 10K
R97 47K
D19 D20
RA2 10K×4
C36 0.01

IC1-5
(X'TAL OSC)

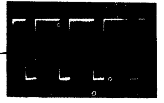


IC1-21
(CTL. PULSE)



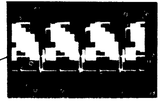
6.4 Vp-p

IC1-22
(CAP. FG)



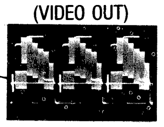
7.2 Vp-p

CONN. 172
(VIDEO IN)



2.0 Vp-p

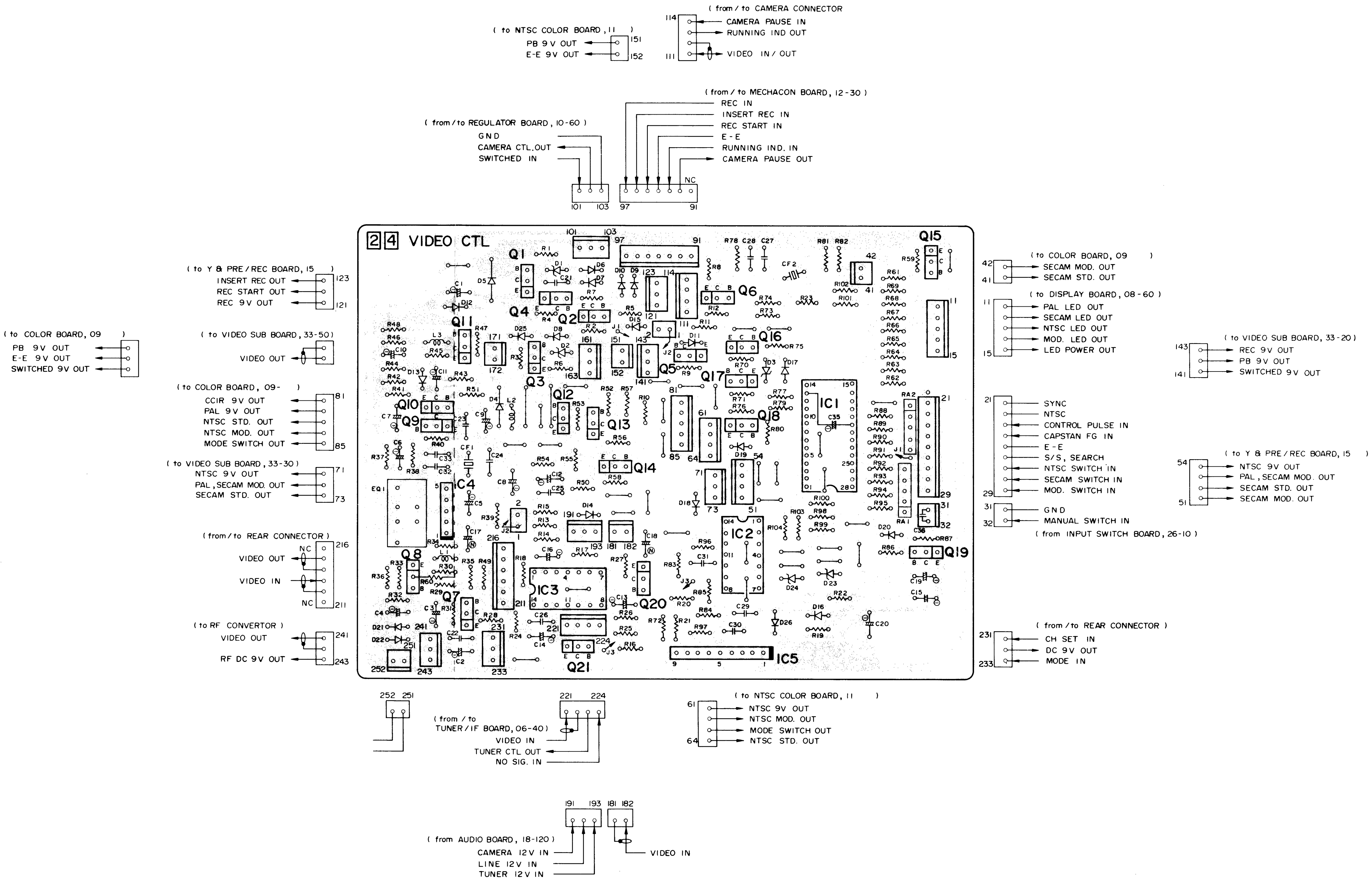
CONN. 182
(VIDEO OUT)



0.94 Vp-p

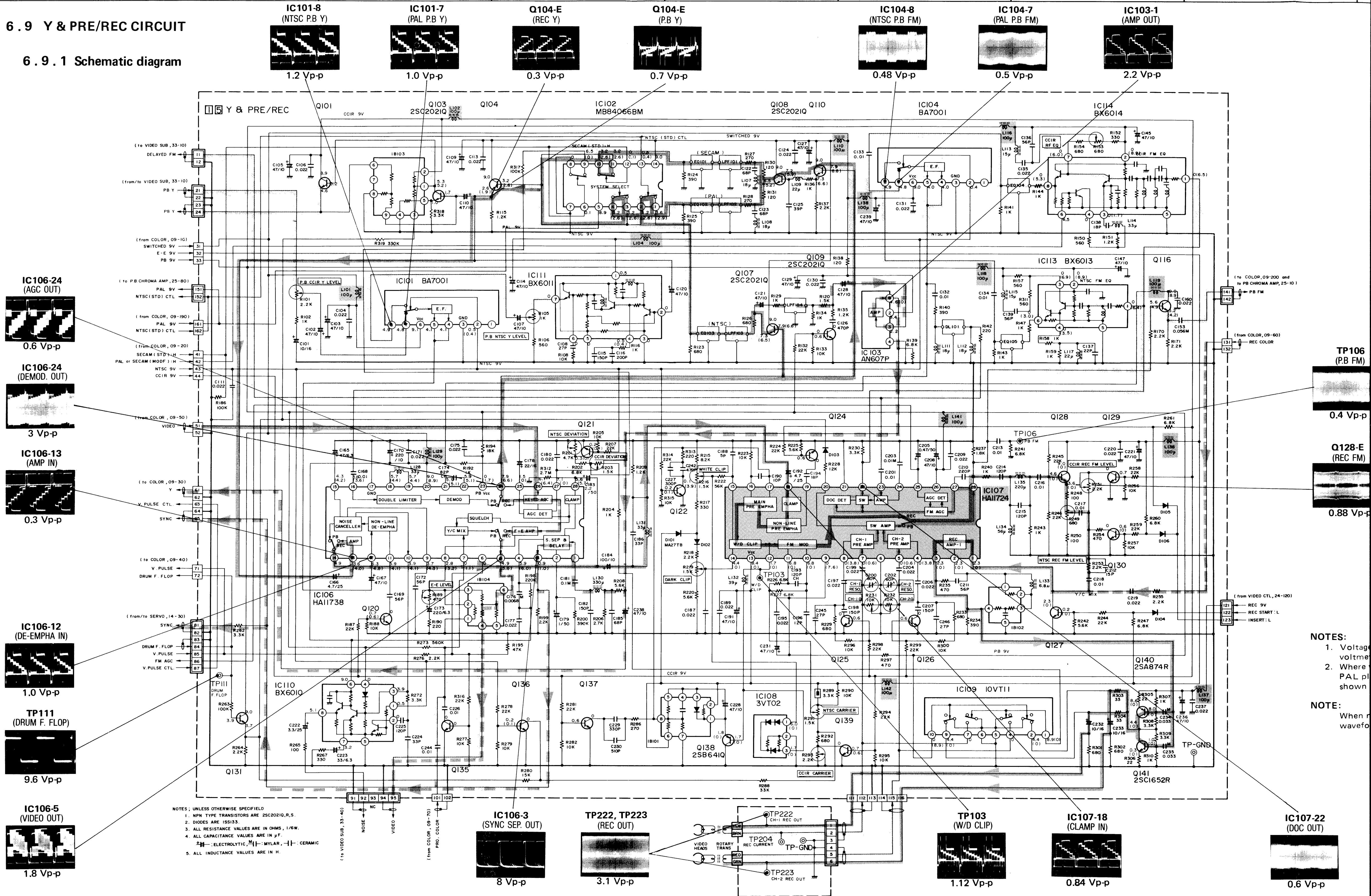
ng ro E-E mode.

6.8.2 Circuit board


24 VIDEO CTL
(to NTSC COLOR BOARD, 11)
PB 9V OUT
E-E 9V OUT
151 152
(from/to CAMERA CONNECTOR)
114 CAMERA PAUSE IN
RUNNING IND OUT
111 VIDEO IN/OUT
(from/to MECHACON BOARD, 12-30)
REC IN
INSERT REC IN
REC START IN
E-E
RUNNING IND. IN
CAMERA PAUSE OUT
(from/to REGULATOR BOARD, 10-60)
GND
CAMERA CTL.OUT
SWITCHED IN
101 103 97 91 NC
(to Y & PRE/REC BOARD, 15)
INSERT REC OUT
REC START OUT
REC 9V OUT
123 121
(to COLOR BOARD, 09)
PB 9V OUT
E-E 9V OUT
SWITCHED 9V OUT
(to VIDEO SUB BOARD, 33-50)
VIDEO OUT
(to COLOR BOARD, 09-)
CCIR 9V OUT
PAL 9V OUT
NTSC STD. OUT
NTSC MOD. OUT
MODE SWITCH OUT
81 85
(to VIDEO SUB BOARD, 33-30)
NTSC 9V OUT
PAL, SECAM MOD. OUT
SECAM STD. OUT
71 73
(from/to REAR CONNECTOR)
VIDEO OUT
VIDEO IN
NC 216 211
(to RF CONVERTOR)
VIDEO OUT
RF DC 9V OUT
241 243
(to COLOR BOARD, 09)
SECAM MOD. OUT
SECAM STD. OUT
42 41
(to DISPLAY BOARD, 08-60)
PAL LED OUT
SECAM LED OUT
NTSC LED OUT
MOD. LED OUT
LED POWER OUT
11 15
(to VIDEO SUB BOARD, 33-20)
REC 9V OUT
PB 9V OUT
SWITCHED 9V OUT
143 141
SYNC
NTSC
CONTROL PULSE IN
CAPSTAN FG IN
E-E
S/S, SEARCH
NTSC SWITCH IN
SECAM SWITCH IN
MOD. SWITCH IN
21 29
(to Y & PRE/REC BOARD, 15)
NTSC 9V OUT
PAL, SECAM MOD. OUT
SECAM STD. OUT
SECAM MOD. OUT
54 51
GND
MANUAL SWITCH IN
31 32
(from INPUT SWITCH BOARD, 26-10)
(from/to REAR CONNECTOR)
CH SET IN
DC 9V OUT
MODE IN
231 233
252 251
221 224
(from/to TUNER/IF BOARD, 06-40)
VIDEO IN
TUNER CTL OUT
NO SIG. IN
(to NTSC COLOR BOARD, 11)
NTSC 9V OUT
NTSC MOD. OUT
MODE SWITCH OUT
NTSC STD. OUT
61 64
191 193 181 182
(from AUDIO BOARD, 18-120)
CAMERA 12V IN
LINE 12V IN
TUNER 12V IN
VIDEO IN
Q1 Q2 Q3 Q4 Q5 Q6 Q7 Q8 Q9 Q10 Q11 Q12 Q13 Q14 Q15 Q16 Q17 Q18 Q19 Q20 Q21
IC1 IC2 IC3 IC4 IC5
E C B

6.9 Y & PRE/REC CIRCUIT

6.9.1 Schematic diagram


IC101-8 (NTSC P.B Y) 1.2 Vp-p
IC101-7 (PAL P.B Y) 1.0 Vp-p
Q104-E (REC Y) 0.3 Vp-p
Q104-E (P.B Y) 0.7 Vp-p
IC104-8 (NTSC P.B FM) 0.48 Vp-p
IC104-7 (PAL P.B FM) 0.5 Vp-p
IC103-1 (AMP OUT) 2.2 Vp-p
IC106-24 (AGC OUT) 0.6 Vp-p
IC106-24 (DEMOD. OUT) 3 Vp-p
IC106-13 (AMP IN) 0.3 Vp-p
IC106-12 (DE-EMPHA IN) 1.0 Vp-p
TP111 (DRUM F. FLOP) 9.6 Vp-p
IC106-5 (VIDEO OUT) 1.8 Vp-p
IC106-3 (SYNC SEP. OUT) 8 Vp-p
TP222, TP223 (REC OUT) 3.1 Vp-p
TP103 (W/D CLIP) 1.12 Vp-p
IC107-18 (CLAMP IN) 0.84 Vp-p
IC107-22 (DOC OUT) 0.6 Vp-p
TP106 (P.B FM) 0.4 Vp-p
Q128-E (REC FM) 0.88 Vp-p
15 Y & PRE/REC
IC101 BA7001
IC102 MB84066BM
IC103 AN607P
IC104 BA7001
IC106 HA11738
IC107 HA11724
IC108 3VT02
IC109 10VT11
IC110 BX6010
IC111 BX6011
IC113 BX6013
IC114 BX6014
Q140 2SA874R
Q141 2SC1652R
Q138 2SB641Q
VIDEO HEADS
ROTARY TRANS
TP-GND

NOTES; UNLESS OTHERWISE SPECIFIELD

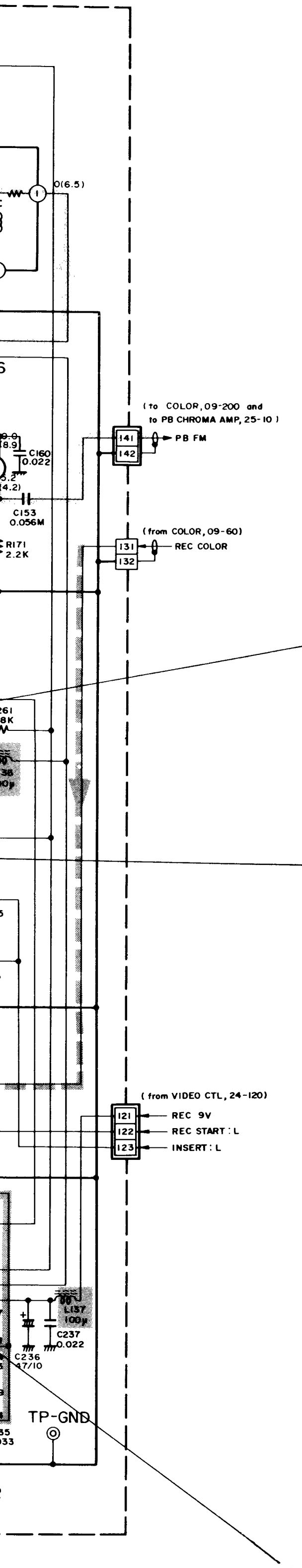
1. NPN TYPE TRANSISTORS ARE 2SC2021Q,R,S.
2. DIODES ARE 1SS133.
3. ALL RESISTANCE VALUES ARE IN OHMS, 1/6W.
4. ALL CAPACITANCE VALUES ARE IN μF.
   ⊣⊢ : ELECTROLYTIC, ⊣⊢ : MYLAR, ⊣⊢ : CERAMIC
5. ALL INDUCTANCE VALUES ARE IN H.

NOTES:

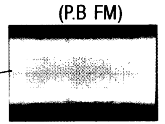
1. Voltag
   voltme
2. Where
   PAL pl
   shown

NOTE:

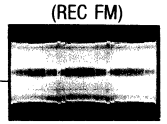
When
wavefo


(to COLOR, 09-200 and to PB CHROMA AMP, 25-10)
141
142
PB FM
(from COLOR, 09-60)
131
132
REC COLOR
(from VIDEO CTL, 24-120)
121
122
123
REC 9V
REC START : L
INSERT : L
TP-GND

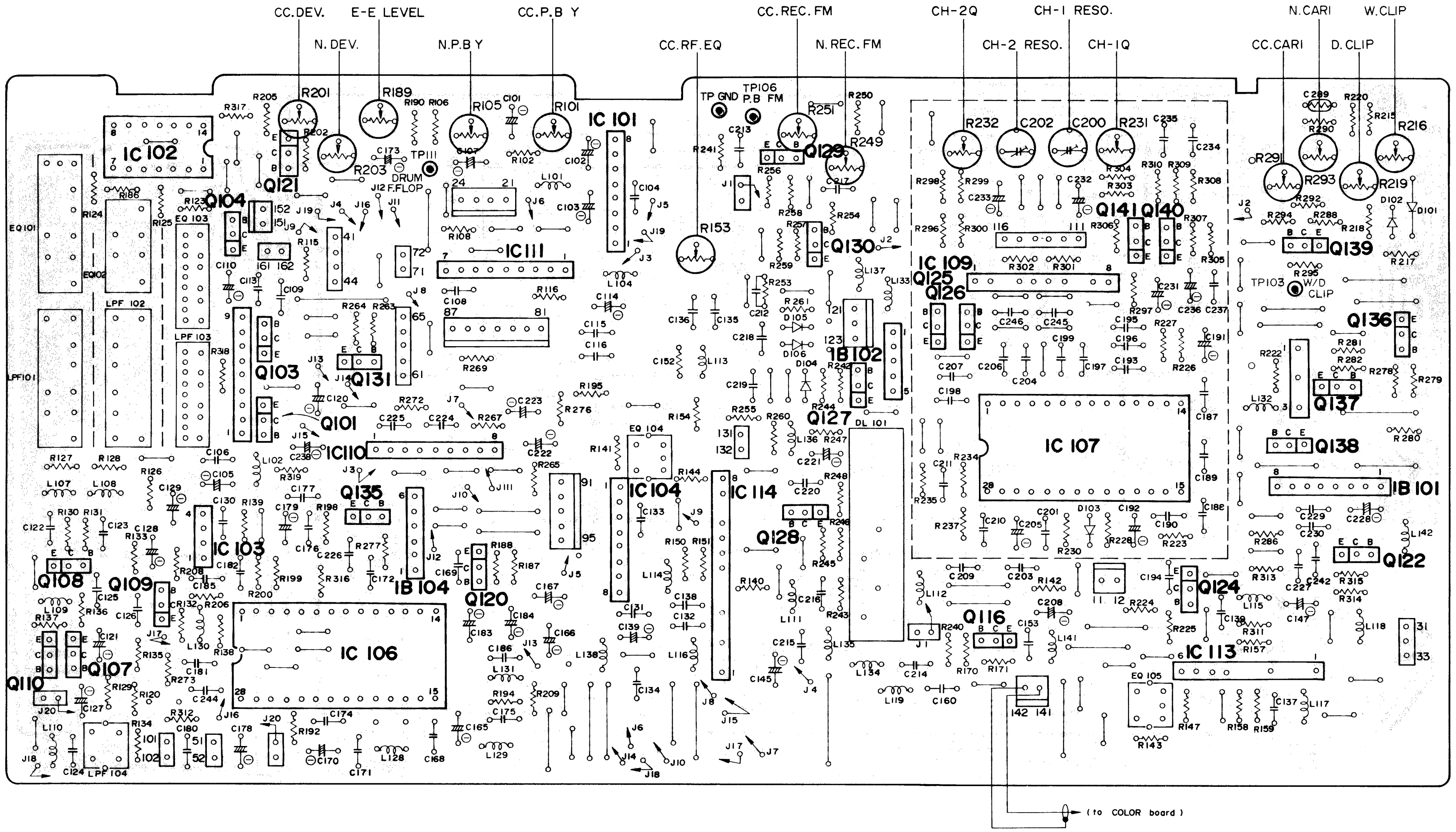
6.9.2 Circuit boards

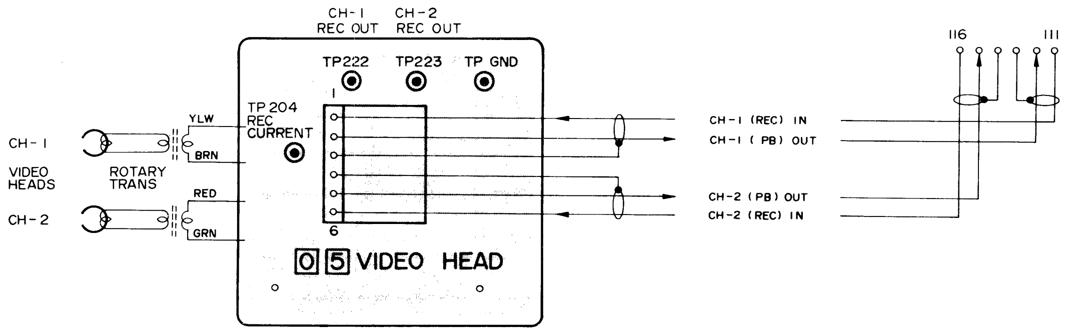


TP106
(P.B FM)
0.4 Vp-p



Q128-E
(REC FM)
0.88 Vp-p


CC.DEV.
N. DEV.
E-E LEVEL
N.P.B Y
CC.P.B Y
CC.RF.EQ
CC.REC. FM
N. REC. FM
CH-2Q
CH-2 RESO.
CH-I RESO.
CH-IQ
CC.CARI
N.CARI
D.CLIP
W.CLIP
IC 101
IC 102
IC 103
IC 104
IC 106
IC 107
IC 109
IC 110
IC 111
IC 113
IC 114
IB 101
IB 102
IB 104
TP GND
TP106 P.B FM
TP111
TP103 W/D CLIP
DRUM J12 F.FLOP
DL 101
LPF 102
LPF 103
LPF 104
EQ 101
EQ 102
EQ 103
EQ 104
EQ 105
(to COLOR board)

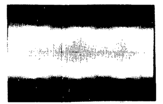

CH-1 REC OUT
CH-2 REC OUT
TP222
TP223
TP GND
TP 204 REC CURRENT
CH-1
VIDEO HEADS
ROTARY TRANS
CH-2
YLW
BRN
RED
GRN
CH-1 (REC) IN
CH-1 (PB) OUT
CH-2 (PB) OUT
CH-2 (REC) IN
116
111
05 VIDEO HEAD

NOTES:

1. Voltages are DC-measured with a digital voltmeter during recording mode.
2. Where voltage differs between PAL recording and PAL playback, the voltage during playback mode is shown in parentheses.

NOTE:

When not specified, waveform is recording ro E-E mode.

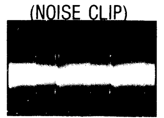


IC107-22
(DOC OUT)
0.6 Vp-p

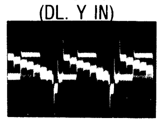
6 . 10 VIDEO SUB CIRCUIT

6 . 10 . 1 Schematic diagram

TP1
(NOISE CLIP)

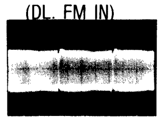


IC1-10
(DL. Y IN)



0.3 Vp-p

IC1-2
(DL. FM IN)

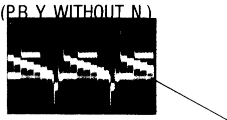


0.06 Vp-p

NOTES:
1. Voltages are DC-measured with a digital voltmeter during recording mode.
2. Where voltage differs between PAL recording and PAL playback, the voltage during playback mode is shown in parentheses.

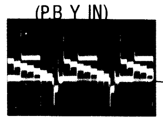
NOTE:
When not specified, waveform is PAL recording ro E-E mode.

IC1-16
(P.B Y WITHOUT N)



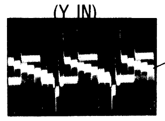
2 Vp-p

IC1-15
(P.B Y IN)



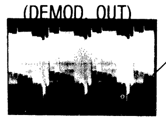
2 Vp-p

IC1-11
(Y IN)



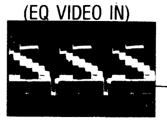
0.3 Vp-p

IC1-9
(DEMOD. OUT)

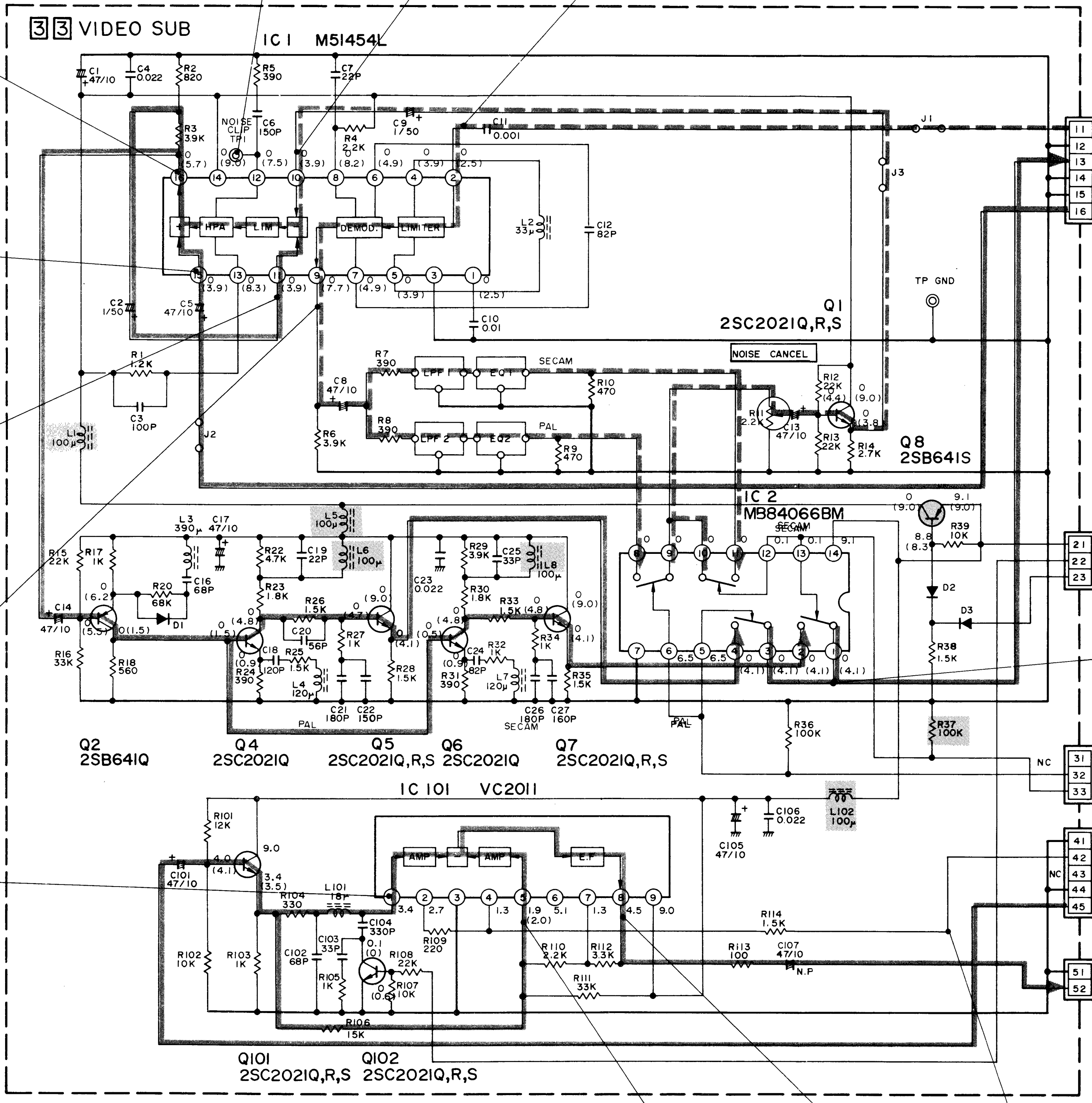


1.2 Vp-p

IC101-1
(EQ VIDEO IN)

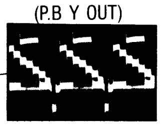


1.9 Vp-p


33 VIDEO SUB
IC1 M51454L
HPA
LIM
DEMOD.
LIMITER
NOISE CLIP TP1
TP GND
J1
J2
J3
Q1 2SC2021Q,R,S
NOISE CANCEL
Q8 2SB641S
SECAM
PAL
LPF 1
EQ 1
LPF 2
EQ 2
IC 2 MB84066BM
SECAM
D1
D2
D3
Q2 2SB641Q
Q4 2SC2021Q
Q5 2SC2021Q,R,S
Q6 2SC2021Q
Q7 2SC2021Q,R,S
IC 101 VC2011
AMP
AMP
E.F
Q101 2SC2021Q,R,S
Q102 2SC2021Q,R,S
(from/to Y & PRE/REC BOARD, 15-10,20)
11 DELAYED FM IN
12 GND
13 PB Y OUT
14 GND
15 GND
16 PB Y IN
(from VIDEO CTL. BOARD, 24-140)
21 SWITCHED 9V IN
22 PB 9V IN
23 REC 9V IN
(from VIDEO CTL. BOARD, 24-70)
NC
31 NTSC 9V
32 PAL or SECAM (MODF) : H
33 SECAM (STD) : H
(from Y & PRE/REC BOARD, 15-90)
41 GND
42 NOISE IN
NC 43 —
44 GND
45 VIDEO IN
(to VIDEO CTL. BOARD, 24-170)
51 GND
52 VIDEO OUT

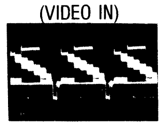
NOTES : UNLESS OTHERWISE SPECIFIED :
1. DIODES ARE 1SS133.
2. ALL RESISTANCE ARE IN OHMS, 1/6W.
3. ALL CAPACITANCE VALUES ARE IN μF.
ELECTOLYTIC
MYLAR
CERAMIC
4. ALL INDUCTANCE VALUES ARE IN H.

IC2-1
(P.B Y OUT)



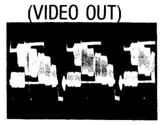
2.25 Vp-p

IC101-5
(VIDEO IN)



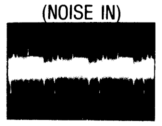
0.72 Vp-p

IC101-8
(VIDEO OUT)

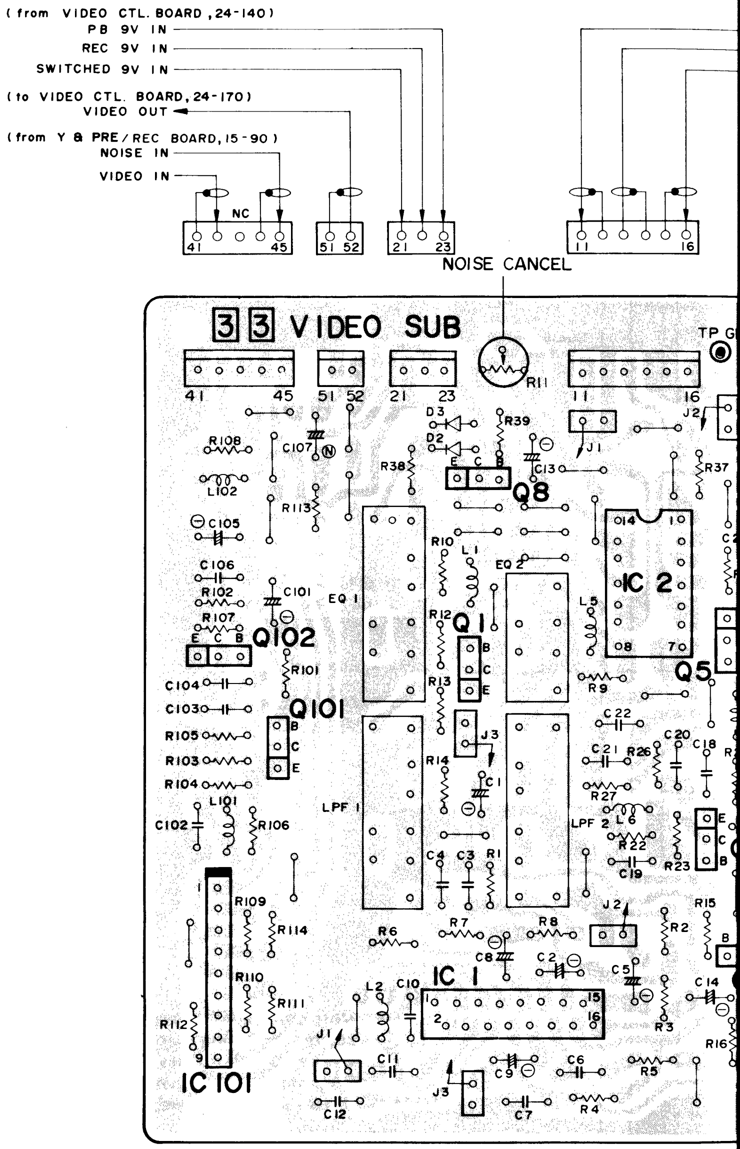


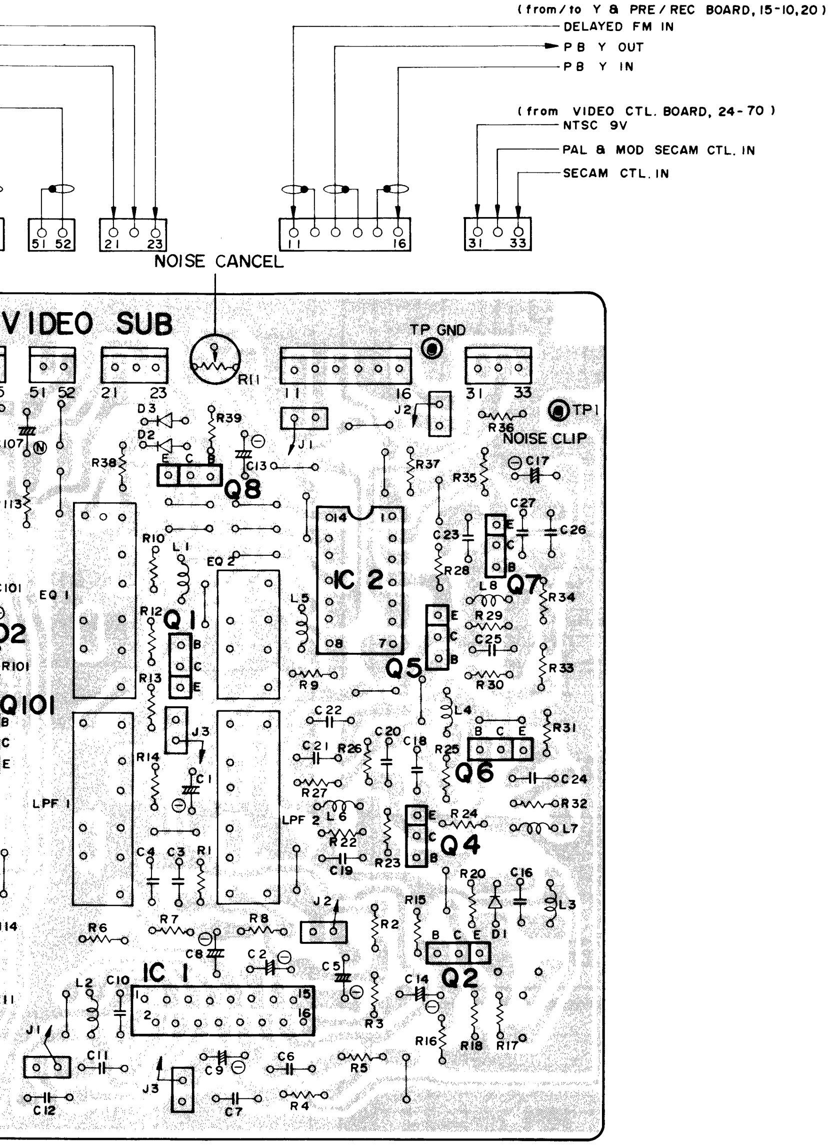
2.0 Vp-p

CONN. 42
(NOISE IN)



6 . 10 . 2 Circuit board

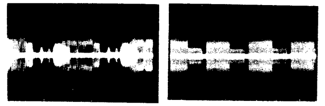

(from VIDEO CTL. BOARD, 24-140)
PB 9V IN
REC 9V IN
SWITCHED 9V IN
(to VIDEO CTL. BOARD, 24-170)
VIDEO OUT
(from Y & PRE/REC BOARD, 15-90)
NOISE IN
VIDEO IN
NC
41 45
51 52
21 23
11 16
NOISE CANCEL
33 VIDEO SUB
R11
Q8
Q102
Q101
Q1
Q5
IC 2
IC 1
IC 101
EQ 1
EQ 2
LPF 1
LPF 2
J1
J2
J3


(from/to Y & PRE/REC BOARD, 15-10,20)
DELAYED FM IN
PB Y OUT
PB Y IN
(from VIDEO CTL. BOARD, 24-70)
NTSC 9V
PAL & MOD SECAM CTL. IN
SECAM CTL. IN
NOISE CANCEL
VIDEO SUB
TP GND
R11
NOISE CLIP
TP1
IC 2
IC 1
Q1
Q2
Q4
Q5
Q6
Q7
Q8
Q101
EQ 1
EQ 2
LPF 1
LPF 2

6.11 PB CHROMA AMP CIRCUIT

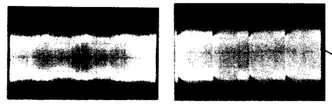
6.11.1 Schematic diagram

IC2-2
(P.B CHROMA AMP IN)

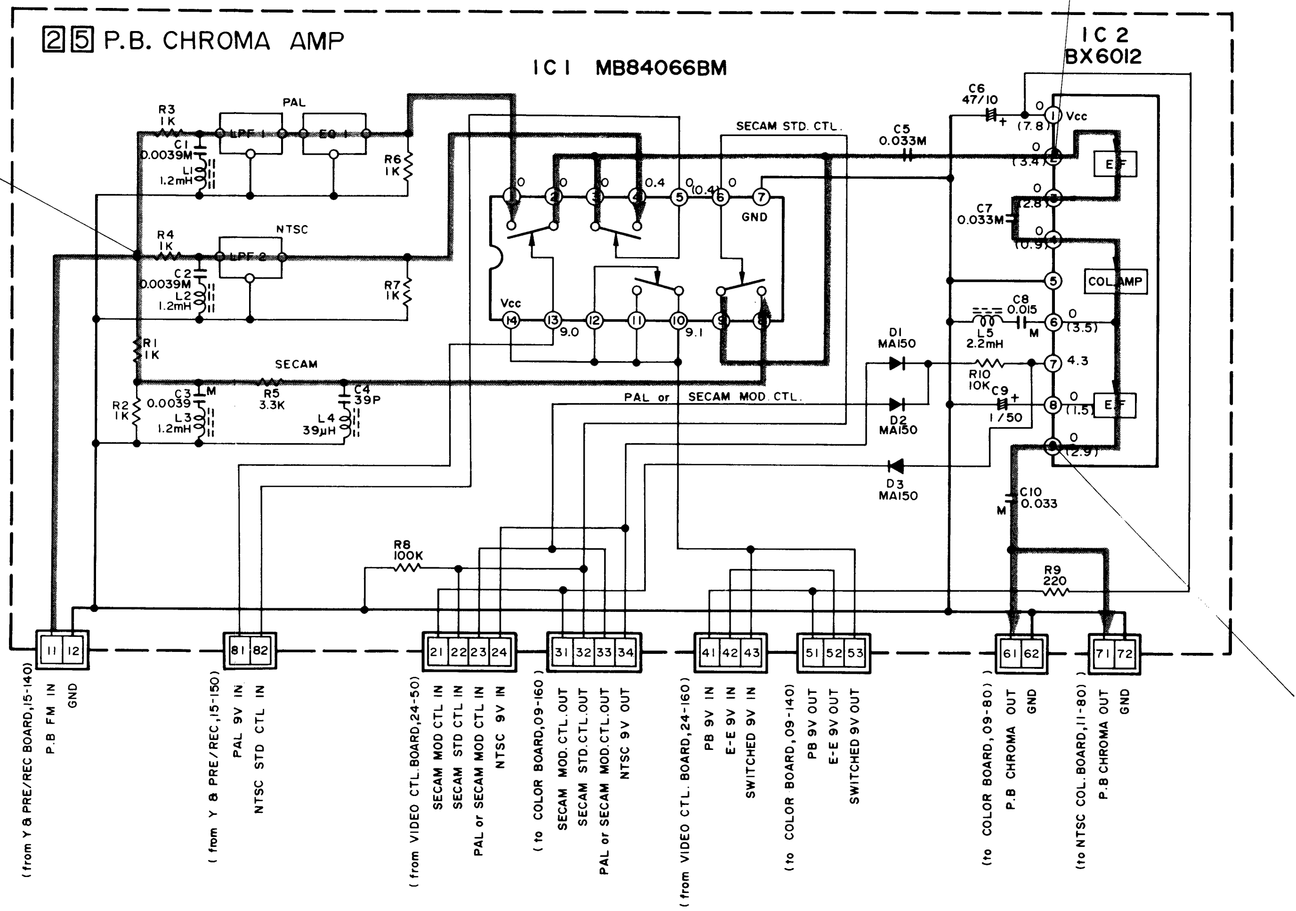


30 mVp-p

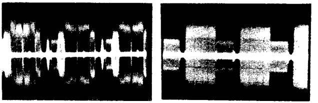
CONN. 11
(P.B FM IN)



35 mVp-p


25 P.B. CHROMA AMP
IC1 MB84066BM
IC 2
BX6012
PAL
LPF 1
EQ 1
NTSC
LPF 2
SECAM
R3 1K
R4 1K
R1 1K
R2 1K
R5 3.3K
R6 1K
R7 1K
R8 100K
R9 220
R10 10K
C1 0.0039M
C2 0.0039M
C3 0.0039M
C4 39P
C5 0.033M
C6 47/10
C7 0.033M
C8 0.015
C9 1/50
C10 0.033
L1 1.2mH
L2 1.2mH
L3 1.2mH
L4 39μH
L5 2.2mH
D1 MA150
D2 MA150
D3 MA150
SECAM STD. CTL.
PAL or SECAM MOD CTL.
GND
Vcc
E.F
COL.AMP
(from Y & PRE/REC BOARD, 15-140)
P.B FM IN
GND
(from Y & PRE/REC, 15-150)
PAL 9V IN
NTSC STD CTL IN
(from VIDEO CTL. BOARD, 24-50)
SECAM MOD CTL IN
SECAM STD CTL IN
PAL or SECAM MOD CTL IN
NTSC 9V IN
(to COLOR BOARD, 09-160)
SECAM MOD. CTL. OUT
SECAM STD. CTL. OUT
PAL or SECAM MOD. CTL. OUT
NTSC 9V OUT
(from VIDEO CTL. BOARD, 24-160)
PB 9V IN
E-E 9V IN
SWITCHED 9V IN
(to COLOR BOARD, 09-140)
PB 9V OUT
E-E 9V OUT
SWITCHED 9V OUT
(to COLOR BOARD, 09-80)
P.B CHROMA OUT
GND
(to NTSC COL. BOARD, 11-80)
P.B CHROMA OUT
GND

IC2-9
(P.B CHROMA AMP OUT)



0.6 Vp-p

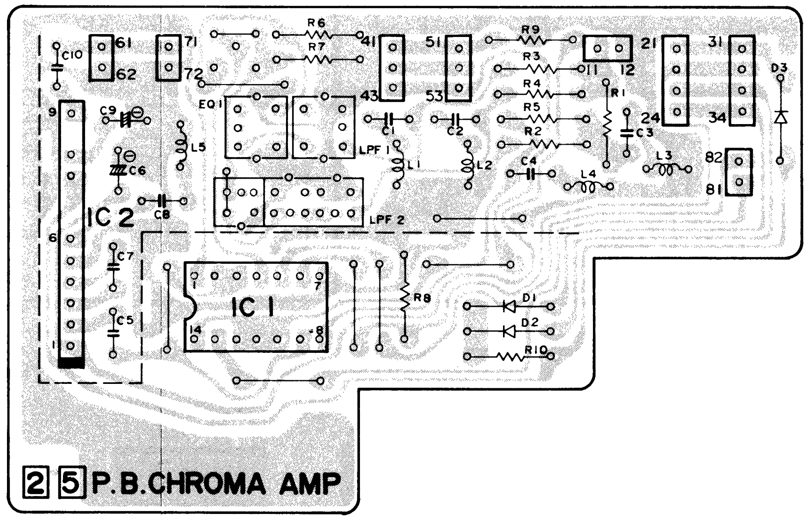
NOTE:

1. Voltage are DC-measured with a digital voltmeter during PAL playback mode.

NOTE:

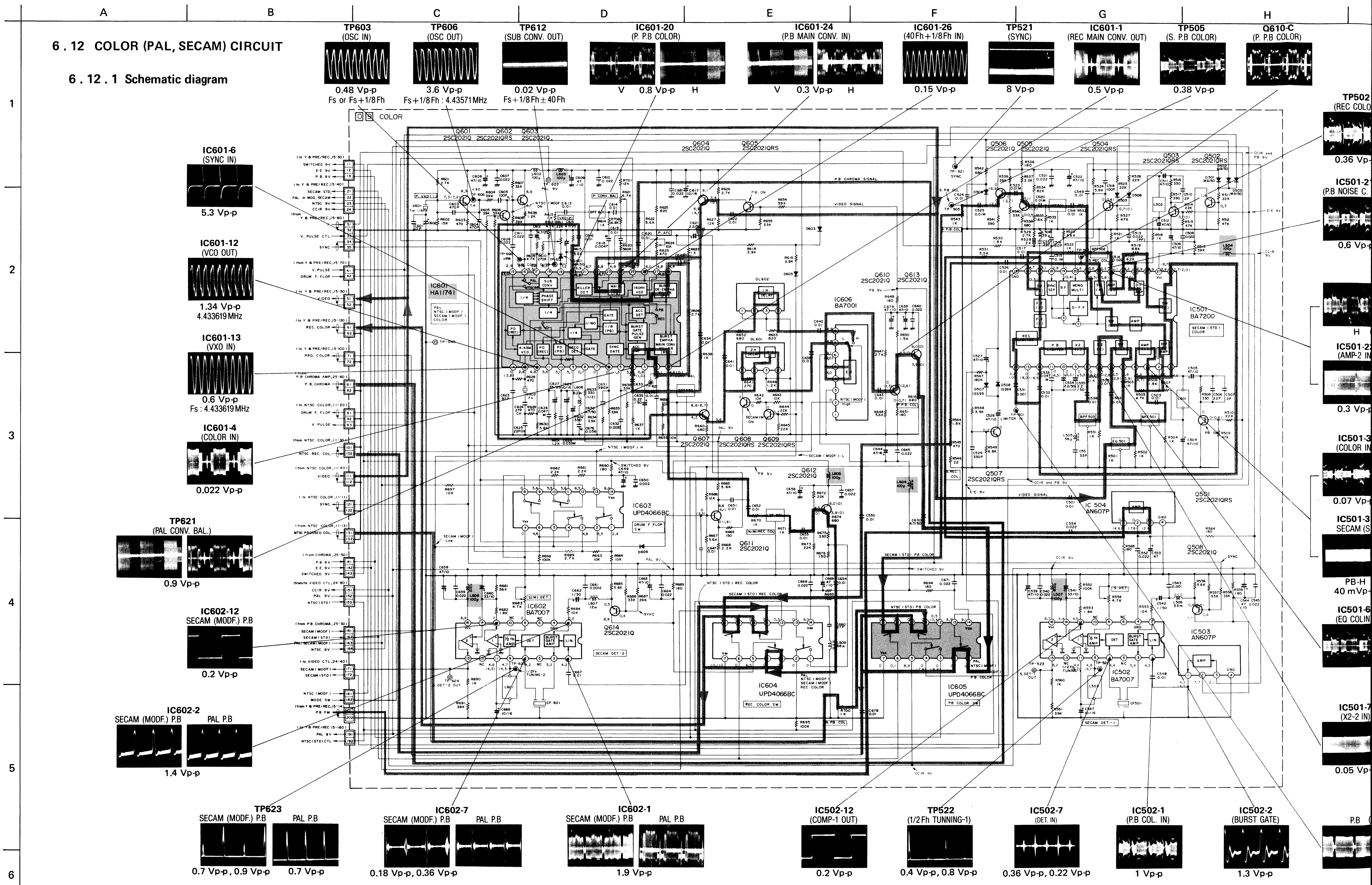
Waveform is PAL playback mode.

6.11.2 Circuit board


25 P.B.CHROMA AMP
IC 2
IC 1
EQ 1
LPF 1
LPF 2
D1
D2
D3
R1
R2
R3
R4
R5
R6
R7
R8
R9
R10
C1
C2
C3
C4
C5
C6
C7
C8
C9
C10
L1
L2
L3
L4
L5

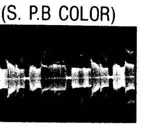
6 . 12 COLOR (PAL, SECAM) CIRCUIT

6 . 12 . 1 Schematic diagram



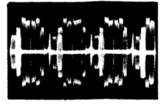
A
B
C
D
E
F
G
H
1
2
3
4
5
6
TP603
(OSC IN)
0.48 Vp-p
Fs or Fs+1/8Fh
TP606
(OSC OUT)
3.6 Vp-p
Fs+1/8Fh : 4.43571MHz
TP612
(SUB CONV. OUT)
0.02 Vp-p
Fs+1/8Fh±40Fh
IC601-20
(P. P.B COLOR)
V 0.8 Vp-p H
IC601-24
(P.B MAIN CONV. IN)
V 0.3 Vp-p H
IC601-26
(40Fh+1/8Fh IN)
0.15 Vp-p
TP521
(SYNC)
8 Vp-p
IC601-1
(REC MAIN CONV. OUT)
0.5 Vp-p
TP505
(S. P.B COLOR)
0.38 Vp-p
Q610-C
(P. P.B COLOR)
TP502
(REC COLO
0.36 Vp
IC501-2
(P.B NOISE C.
0.6 Vp
H
IC501-2
(AMP-2 IN
0.3 Vp
IC501-3
(COLOR IN
0.07 Vp
IC501-3
SECAM (S
PB-H
40 mVp
IC501-6
(EQ COLIN
IC501-7
(X2-2 IN)
0.05 Vp
P.B
IC601-6
(SYNC IN)
5.3 Vp-p
IC601-12
(VCO OUT)
1.34 Vp-p
4.433619MHz
IC601-13
(VXO IN)
0.6 Vp-p
Fs : 4.433619MHz
IC601-4
(COLOR IN)
0.022 Vp-p
TP621
(PAL CONV. BAL.)
0.9 Vp-p
IC602-12
SECAM (MODF.) P.B
0.2 Vp-p
IC602-2
SECAM (MODF.) P.B
PAL P.B
1.4 Vp-p
TP623
SECAM (MODF.) P.B
PAL P.B
0.7 Vp-p , 0.9 Vp-p
0.7 Vp-p
IC602-7
SECAM (MODF.) P.B
PAL P.B
0.18 Vp-p, 0.36 Vp-p
IC602-1
SECAM (MODF.) P.B
PAL P.B
1.9 Vp-p
IC502-12
(COMP-1 OUT)
0.2 Vp-p
TP522
(1/2Fh TUNNING-1)
0.4 Vp-p, 0.8 Vp-p
IC502-7
(DET. IN)
0.36 Vp-p, 0.22 Vp-p
IC502-1
(P.B COL. IN)
1 Vp-p
IC502-2
(BURST GATE)
1.3 Vp-p
COLOR
Q601 2SC2021Q
Q602 2SC2021QRS
Q603 2SC2021Q
Q604 2SC2021Q
Q605 2SC2021QRS
Q506 2SC2021Q
Q505 2SC2021Q
Q504 2SC2021QRS
Q503 2SC2021QRS
Q502 2SC2021QRS
IC601 HA11741
PAL NTSC (MODF.) SECAM (MODF.) COLOR
IC606 BA7001
Q610 2SC2021Q
Q613 2SC2021Q
IC501 BA7200
SECAM (STD) COLOR
Q607 2SC2021Q
Q608 2SC2021QRS
Q609 2SC2021QRS
Q507 2SC2021QRS
IC603 UPD4066BC
DRUM F. FLOP SW
Q612 2SC2021Q
Q611 2SC2021Q
IC 504 AN607P
Q501 2SC2021QRS
Q508 2SC2021Q
IC602 BA7007
SECAM DET -2
Q614 2SC2021Q
IC604 UPD4066BC
REC COLOR SW
IC605 UPD4066BC
PB COLOR SW
IC502 BA7007
SECAM DET -1
IC503 AN607P
P.B CHROMA SIGNAL
VIDEO SIGNAL
SECAM (STD) REC COLOR
NTSC (STD) PB COLOR
SECAM (STD) PB COLOR
NTSC (STD) REC COLOR
SWITCHED 9V
CCIR 9V
PAL 9V
PB 9V
E/E 9V

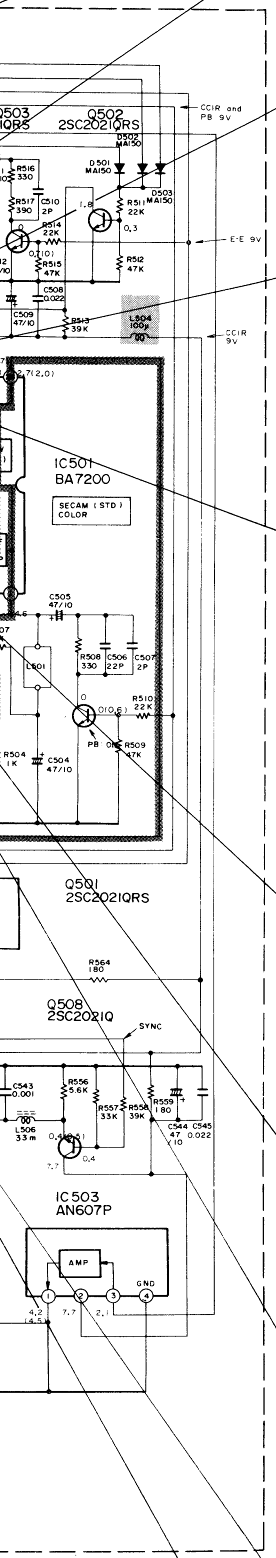
TP505
(S. P.B COLOR)



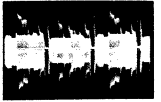
0.38 Vp-p

Q610-C
(P. P.B COLOR)



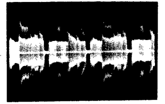


TP502
(REC COLOR)



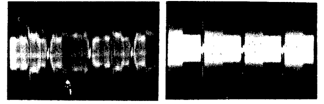
0.36 Vp-p

IC501-21
(P.B NOISE C. OUT)



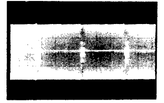
0.6 Vp-p

IC501-23
(AMP-2 IN)



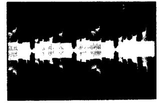
H 0.02 Vp-p V

IC501-23
(AMP-2 IN)



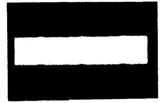
0.3 Vp-p

IC501-3
(COLOR IN)



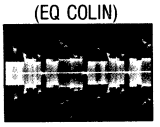
0.07 Vp-p

IC501-3
SECAM (S)

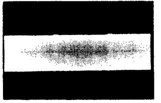


PB-H
40 mVp-p

IC501-6
(EQ COLIN)



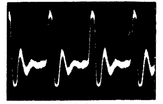
IC501-7
(X2-2 IN)



0.05 Vp-p

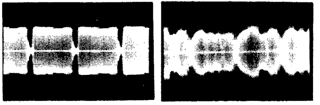
)

IC502-2
(BURST GATE)



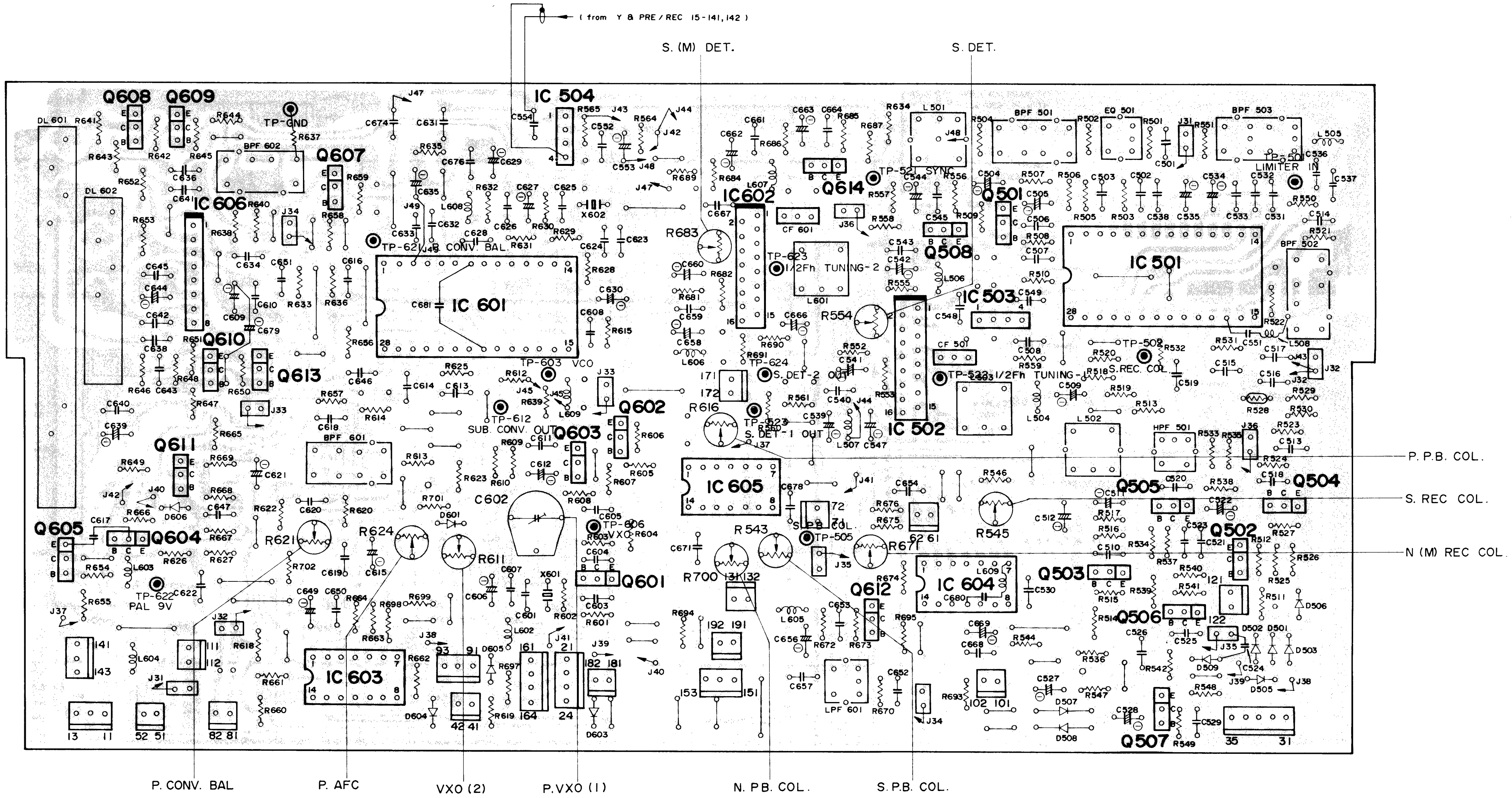
1.3 Vp-p

TP501
P.B (LIMITER IN) REC



0.2 Vp-p

6.12.2 Circuit board



(from Y & PRE/REC 15-141,142)
S. (M) DET.
S. DET.
IC 504
Q608
Q609
Q607
IC 606
IC 601
IC602
Q614
Q501
IC 501
Q508
IC 503
Q610
Q613
Q602
Q603
IC 502
IC 605
Q611
Q605
Q604
IC 603
Q601
Q612
IC 604
Q503
Q505
Q504
Q502
Q506
Q507
TP-GND
TP-621 CONV BAL
TP-603 VCO
TP-612 SUB CONV OUT
TP-606 VXO
TP-622 PAL 9V
TP-623 1/2Fh TUNING-2
TP-624 S. DET-2 OUT
TP-625 S. DET-1 OUT
TP-521 SYNC
TP-522 1/2Fh TUNING-1
TP-503 S.REC COL
TP-505
TP-502 LIMITER IN
S.P.B. COL.
BPF 601
BPF 602
BPF 501
BPF 502
BPF 503
EQ 501
HPF 501
LPF 601
CF 601
CF 501
DL 601
DL 602
P. P.B. COL.
S. REC COL.
N (M) REC COL.
P. CONV. BAL
P. AFC
VXO (2)
P.VXO (1)
N. PB. COL.
S.P.B. COL.

NOTES:

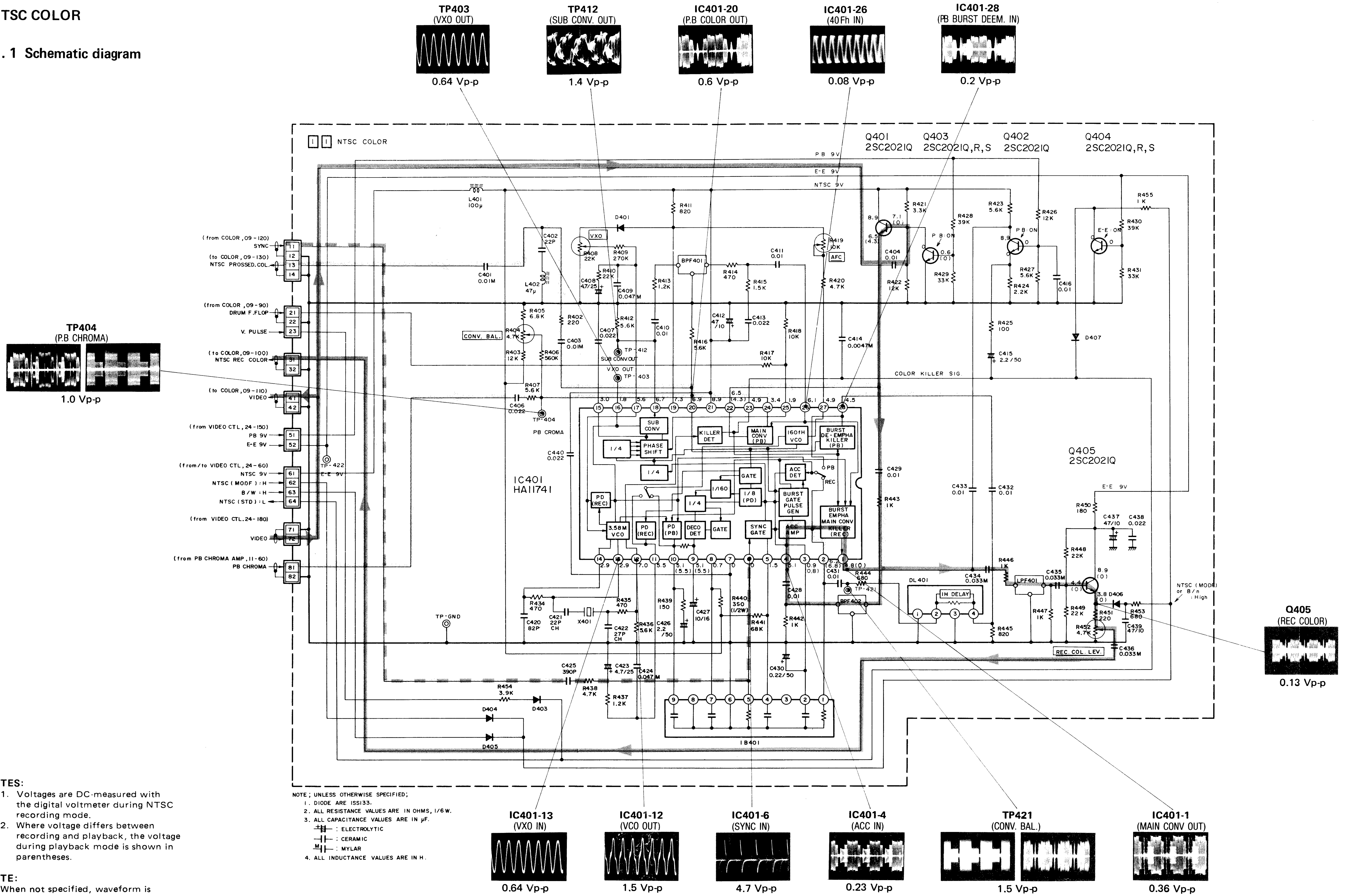
1. Voltages are DC-measured with a digital voltmeter during PAL or SECAM recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode is shown in parentheses.

NOTE:

When not specified, waveform is PAL or SECAM recording mode or E-E mode.

6 . 13 NTSC COLOR

6 . 13 . 1 Schematic diagram

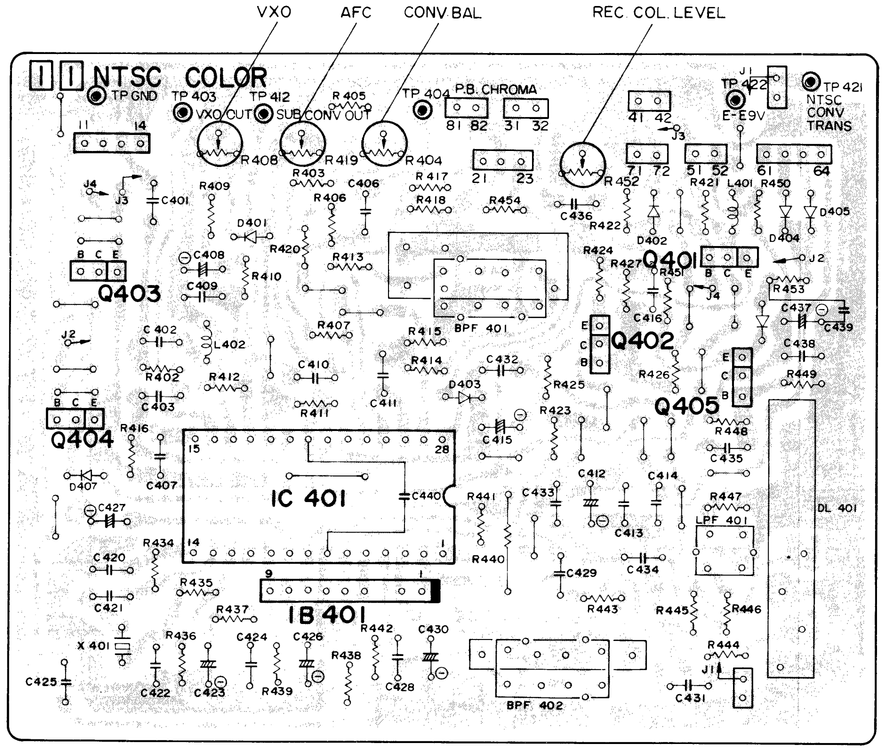

TP403
(VXO OUT)
0.64 Vp-p
TP412
(SUB CONV. OUT)
1.4 Vp-p
IC401-20
(P.B COLOR OUT)
0.6 Vp-p
IC401-26
(40Fh IN)
0.08 Vp-p
IC401-28
(PB BURST DEEM. IN)
0.2 Vp-p
TP404
(P.B CHROMA)
1.0 Vp-p
NTSC COLOR
Q401 2SC2021Q
Q403 2SC2021Q,R,S
Q402 2SC2021Q
Q404 2SC2021Q,R,S
Q405 2SC2021Q
IC401 HA11741
PB 9V
E-E 9V
NTSC 9V
COLOR KILLER SIG
(from COLOR, 09-120) SYNC
(to COLOR, 09-130) NTSC PROSSED.COL.
(from COLOR, 09-90) DRUM F.FLOP
V. PULSE
(to COLOR, 09-100) NTSC REC COLOR
(to COLOR, 09-110) VIDEO
(from VIDEO CTL, 24-150) PB 9V
E-E 9V
(from/to VIDEO CTL, 24-60) NTSC 9V
NTSC (MODE) : H
B/W : H
NTSC (STD) : L
(from VIDEO CTL. 24-180)
VIDEO
(from PB CHROMA AMP, 11-60) PB CHROMA
SUB CONV
PHASE SHIFT
1/4
KILLER DET
MAIN CONV (PB)
160fH VCO
BURST DE-EMPHA KILLER (PB)
ACC DET
GATE
1/160
1/8 (PD)
BURST GATE PULSE GEN
BURST EMPHA MAIN CONV KILLER (REC)
PD (REC)
3.58M VCO
PD (REC)
PD (PB)
DECO DET
SYNC GATE
ACC AMP
CONV. BAL.
VXO
AFC
BPF401
BPF402
LPF401
DL401
1H DELAY
1B401
REC COL. LEV.
TP-GND
TP-422
TP-421
NTSC (MODE) or B/n : High
Q405
(REC COLOR)
0.13 Vp-p
IC401-13
(VXO IN)
0.64 Vp-p
IC401-12
(VCO OUT)
1.5 Vp-p
IC401-6
(SYNC IN)
4.7 Vp-p
IC401-4
(ACC IN)
0.23 Vp-p
TP421
(CONV. BAL.)
1.5 Vp-p
IC401-1
(MAIN CONV OUT)
0.36 Vp-p

NOTE ; UNLESS OTHERWISE SPECIFIED ;
1. DIODE ARE 1SS133.
2. ALL RESISTANCE VALUES ARE IN OHMS, 1/6W.
3. ALL CAPACITANCE VALUES ARE IN μF.
⊣⊢ : ELECTROLYTIC
⊣⊢ : CERAMIC
⊣⊢ : MYLAR
4. ALL INDUCTANCE VALUES ARE IN H.

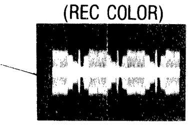
NOTES:
1. Voltages are DC-measured with the digital voltmeter during NTSC recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode is shown in parentheses.

NOTE:
When not specified, waveform is NTSC recording or E-E mode.

6 . 13 . 2 Circuit board


VXO
AFC
CONV BAL
REC COL. LEVEL
NTSC COLOR
TP GND
TP 403
VXO OUT
TP 412
SUB CONV OUT
TP 404
P.B. CHROMA
TP 422
E-E9V
TP 421
NTSC CONV TRANS
R408
R419
R404
R452
Q401
Q402
Q403
Q404
Q405
IC 401
IB 401
BPF 401
BPF 402
LPF 401
DL 401
X 401

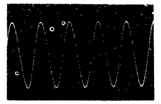
Q405
(REC COLOR)

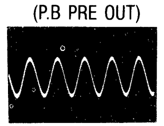


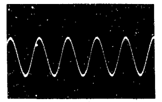
0.13 Vp-p

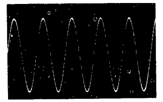
6 . 14 AUDIO CIRCUIT

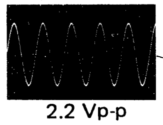
6 . 14 . 1 Schematic diagram

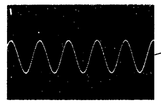

TP11
(AUDIO IN)
220 mVp-p


IC2-4
(P.B PRE OUT)
16 mVp-p

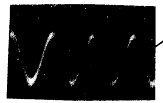

IC3-6
(DOLBY IN)
135 mVp-p

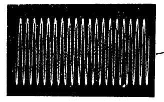

TP14
(MONITOR OUT)
1.1 Vp-p

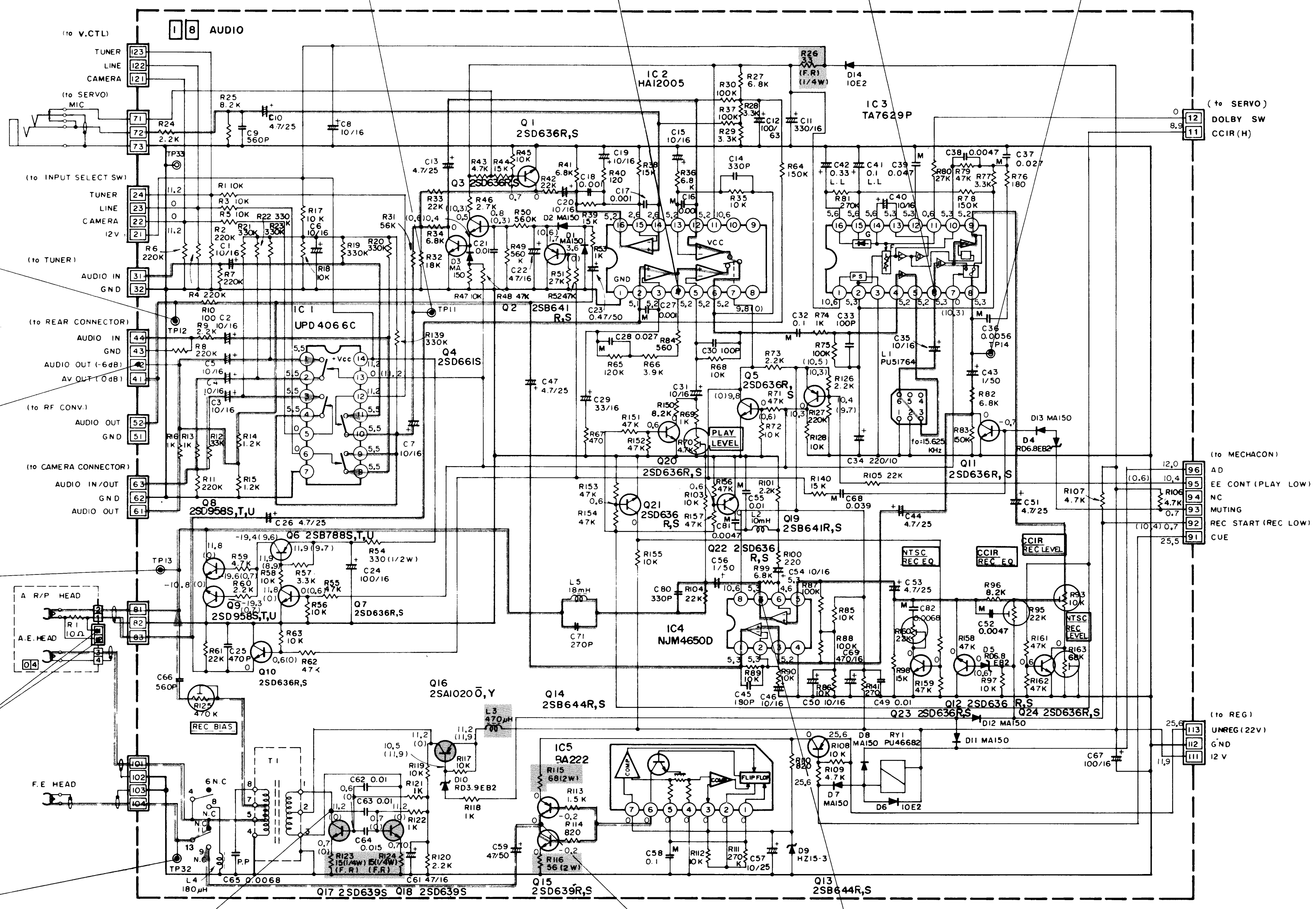

TP12
(AUDIO OUT)
2.2 Vp-p

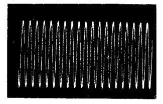

CONN. 42
(AUDIO OUT)
1.1 Vp-p

TP13
(AUDIO HEAD BIAS)
38 Vp-p
70 kHz

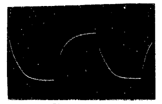

CONN. 12, 11
(REC CURRENT)
2.0 mVrms

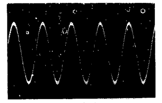

TP32
(F.E. HEAD)
59 Vp-p
70 kHz


1 8 AUDIO
(to V.CTL)
TUNER
LINE
CAMERA
(to SERVO)
MIC
(to INPUT SELECT SW)
TUNER
LINE
CAMERA
12V
(to TUNER)
AUDIO IN
GND
(to REAR CONNECTOR)
AUDIO IN
GND
AUDIO OUT (-6dB)
AV OUT (0dB)
(to RF CONV)
AUDIO OUT
GND
(to CAMERA CONNECTOR)
AUDIO IN/OUT
GND
AUDIO OUT
A R/P HEAD
A.E. HEAD
F.E. HEAD
TP33
TP12
TP13
TP32
TP11
TP14
IC1
UPD4066C
IC2
HA12005
IC3
TA7629P
IC4
NJM4650D
IC5
BA222
Q1 2SD636R,S
Q2 2SB641R,S
Q3 2SD636R,S
Q4 2SD661S
Q5 2SD636R,S
Q6 2SB788S,T,U
Q7 2SD636R,S
Q8 2SD958S,T,U
Q9 2SD958S,T,U
Q10 2SD636R,S
Q11 2SD636R,S
Q12 2SD636R,S
Q13 2SB644R,S
Q14 2SB644R,S
Q15 2SD639R,S
Q16 2SA1020O,Y
Q17 2SD639S
Q18 2SD639S
Q19 2SB641R,S
Q20 2SD636R,S
Q21 2SD636R,S
Q22 2SD636R,S
Q23 2SD636R,S
Q24 2SD636R,S
PLAY LEVEL
REC BIAS
NTSC REC EQ
CCIR REC EQ
CCIR REC LEVEL
NTSC REC LEVEL
L1 PU51764
fo=15.625 kHz
RY1 PU46682
(to SERVO)
DOLBY SW
CCIR(H)
(to MECHACON)
AD
EE CONT (PLAY LOW)
NC
MUTING
REC START (REC LOW)
CUE
(to REG)
UNREG (22V)
GND
12V


Q17-C
(BIAS OSC)
18.5 Vp-p
70 kHz

NOTE UNLESS OTHERWISE SPECIFIED;
1 ALL RESISTANCE VALUES ARE IN OHMS 1/8W
2 ALL CAPACITANCE VALUES ARE IN μF
ELECTROLYTIC
CERAMIC OR MYLAR


Q15-C
(CUE OSC OUT)
15.5 Vp-p
30 Hz


IC4-7
(REC OUT)
1.4 Vp-p

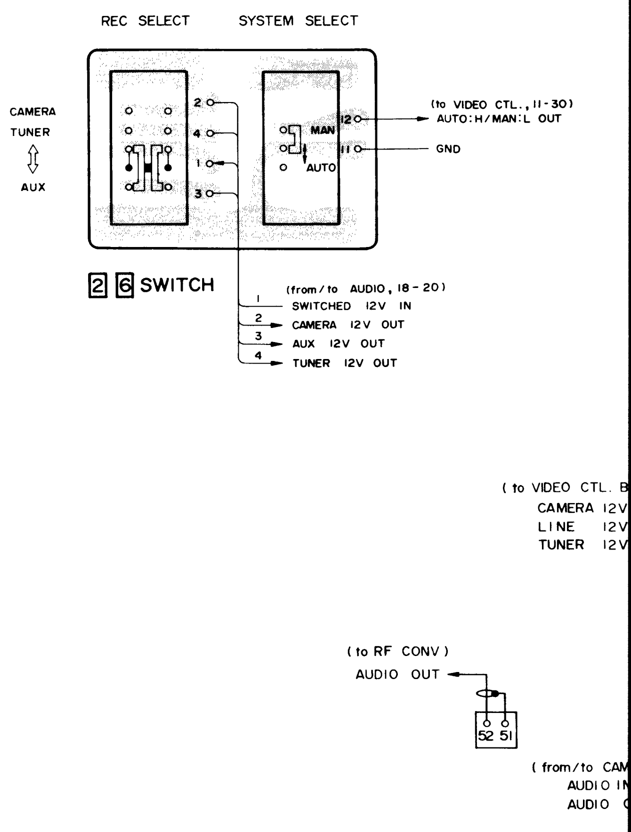
NOTES:

1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode is shown in parentheses.

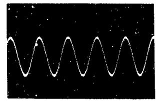
NOTE:

When not specified, waveform is recording ro E-E mode.

6 . 14 . 2 Circuit board

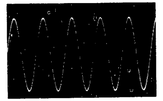

REC SELECT
SYSTEM SELECT
CAMERA
TUNER
AUX
(to VIDEO CTL., 11-30)
AUTO:H/MAN:L OUT
GND
MAN
AUTO
2 6 SWITCH
(from/to AUDIO, 18-20)
SWITCHED 12V IN
CAMERA 12V OUT
AUX 12V OUT
TUNER 12V OUT
(to VIDEO CTL.
CAMERA 12V
LINE 12V
TUNER 12V
(to RF CONV)
AUDIO OUT
52 51
(from/to CAM
AUDIO I
AUDIO

IC3-6
(DOLBY IN)



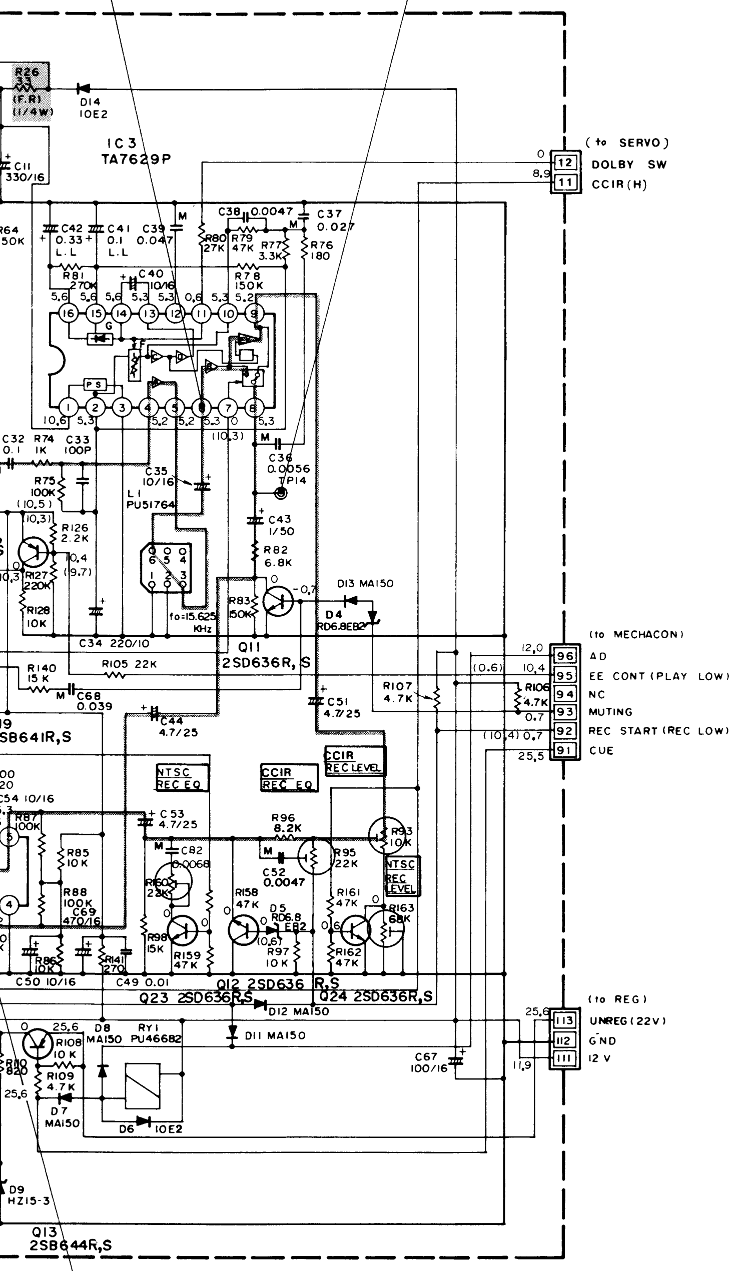
135 mVp-p

TP14
(MONITOR OUT)

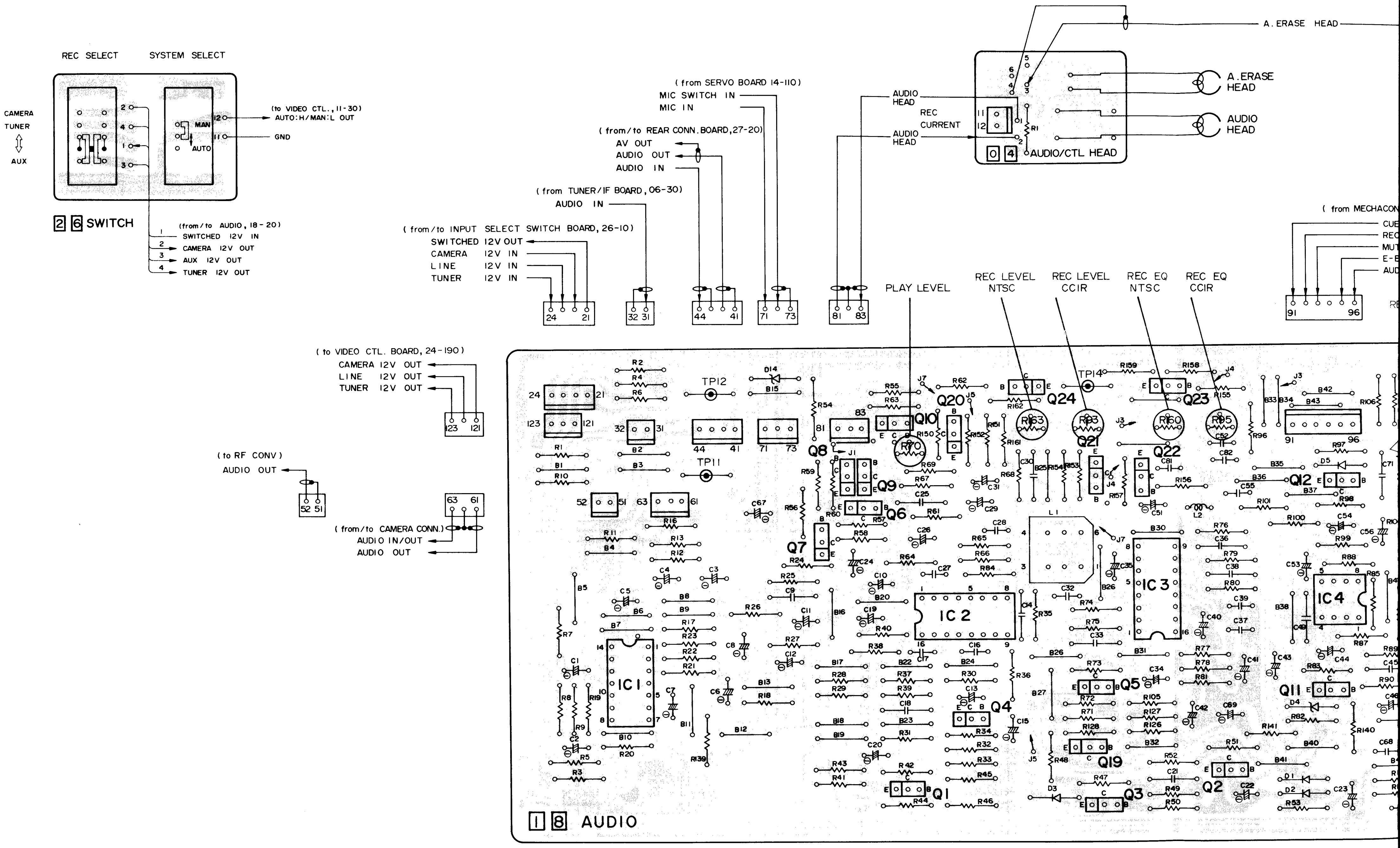


1.1 Vp-p

6 . 14 . 2 Circuit board



R26 33 (F.R) (1/4W)
D14 10E2
IC3 TA7629P
C11 330/16
C42 0.33
C41 0.1
C39 0.047
C38 0.0047
C37 0.027
R80 27K
R79 47K
R77 3.3K
R76 180
R81 270K
R78 150K
C40 10/16
C36 0.0056
TP14
C35 10/16
L1 PU51764
C43 1/50
R82 6.8K
D13 MA150
R83 150K
D4 RD6.8EB2
Q11 2SD636R,S
C34 220/10
R105 22K
R140 15K
C68 0.039
C44 4.7/25
C51 4.7/25
R107 4.7K
R106 4.7K
NTSC REC EQ
CCIR REC EQ
CCIR REC LEVEL
NTSC REC LEVEL
C53 4.7/25
C82 0.068
R96 8.2K
R93 10K
C52 0.0047
R95 22K
R158 47K
R161 47K
R163 68K
R159 47K
R162 47K
R97 10K
D5 RD6.8EB2
R85 10K
R88 100K
C69 470/16
R86 10K
R141 270
C50 10/16
C49 0.01
Q12 2SD636R,S
Q23 2SD636R,S
Q24 2SD636R,S
D12 MA150
D11 MA150
D8 MA150
RY1 PU46682
R108 10K
R109 4.7K
D7 MA150
D6 10E2
C67 100/16
D9 HZ15-3
Q13 2SB644R,S
2SB641R,S
(to SERVO)
12 DOLBY SW
11 CCIR(H)
(to MECHACON)
96 AD
95 EE CONT (PLAY LOW)
94 NC
93 MUTING
92 REC START (REC LOW)
91 CUE
(to REG)
113 UNREG (22V)
112 GND
111 12V

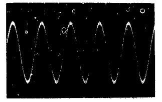


REC SELECT
SYSTEM SELECT
CAMERA
TUNER
AUX
MAN
AUTO
(to VIDEO CTL., 11-30) AUTO:H/MAN:L OUT
GND
26 SWITCH
(from/to AUDIO, 18-20)
1 SWITCHED 12V IN
2 CAMERA 12V OUT
3 AUX 12V OUT
4 TUNER 12V OUT
(from SERVO BOARD 14-110)
MIC SWITCH IN
MIC IN
(from/to REAR CONN. BOARD, 27-20)
AV OUT
AUDIO OUT
AUDIO IN
(from TUNER/IF BOARD, 06-30)
AUDIO IN
(from/to INPUT SELECT SWITCH BOARD, 26-10)
SWITCHED 12V OUT
CAMERA 12V IN
LINE 12V IN
TUNER 12V IN
AUDIO HEAD
REC CURRENT
AUDIO HEAD
04 AUDIO/CTL HEAD
A.ERASE HEAD
A.ERASE HEAD
AUDIO HEAD
(from MECHACON
CUE
PLAY LEVEL
REC LEVEL NTSC
REC LEVEL CCIR
REC EQ NTSC
REC EQ CCIR
(to VIDEO CTL. BOARD, 24-190)
CAMERA 12V OUT
LINE 12V OUT
TUNER 12V OUT
(to RF CONV)
AUDIO OUT
(from/to CAMERA CONN.)
AUDIO IN/OUT
AUDIO OUT
TP12
TP11
TP14
IC1
IC2
IC3
IC4
L1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q19
Q20
Q21
Q22
Q23
Q24
18 AUDIO

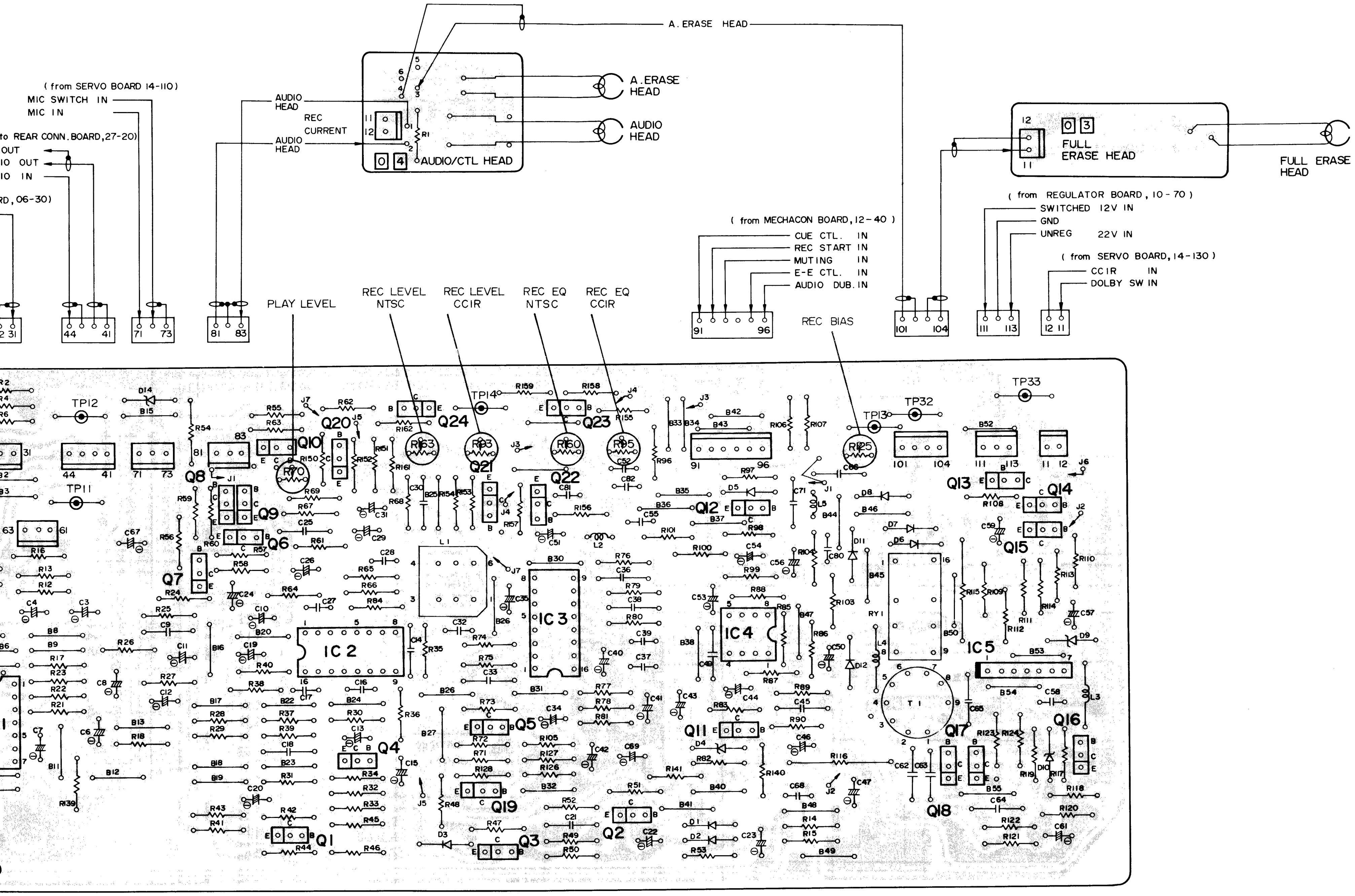
NOTES:
1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode is shown in parentheses.

NOTE:
When not specified,
waveform is recording ro E-E mode.

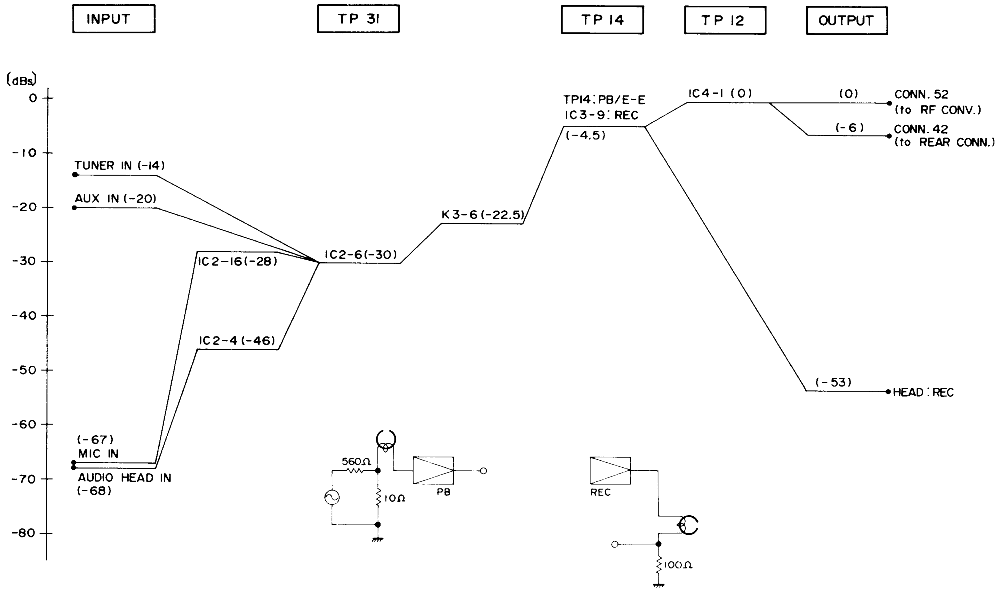
IC4-7
(REC OUT)



1.4 Vp-p

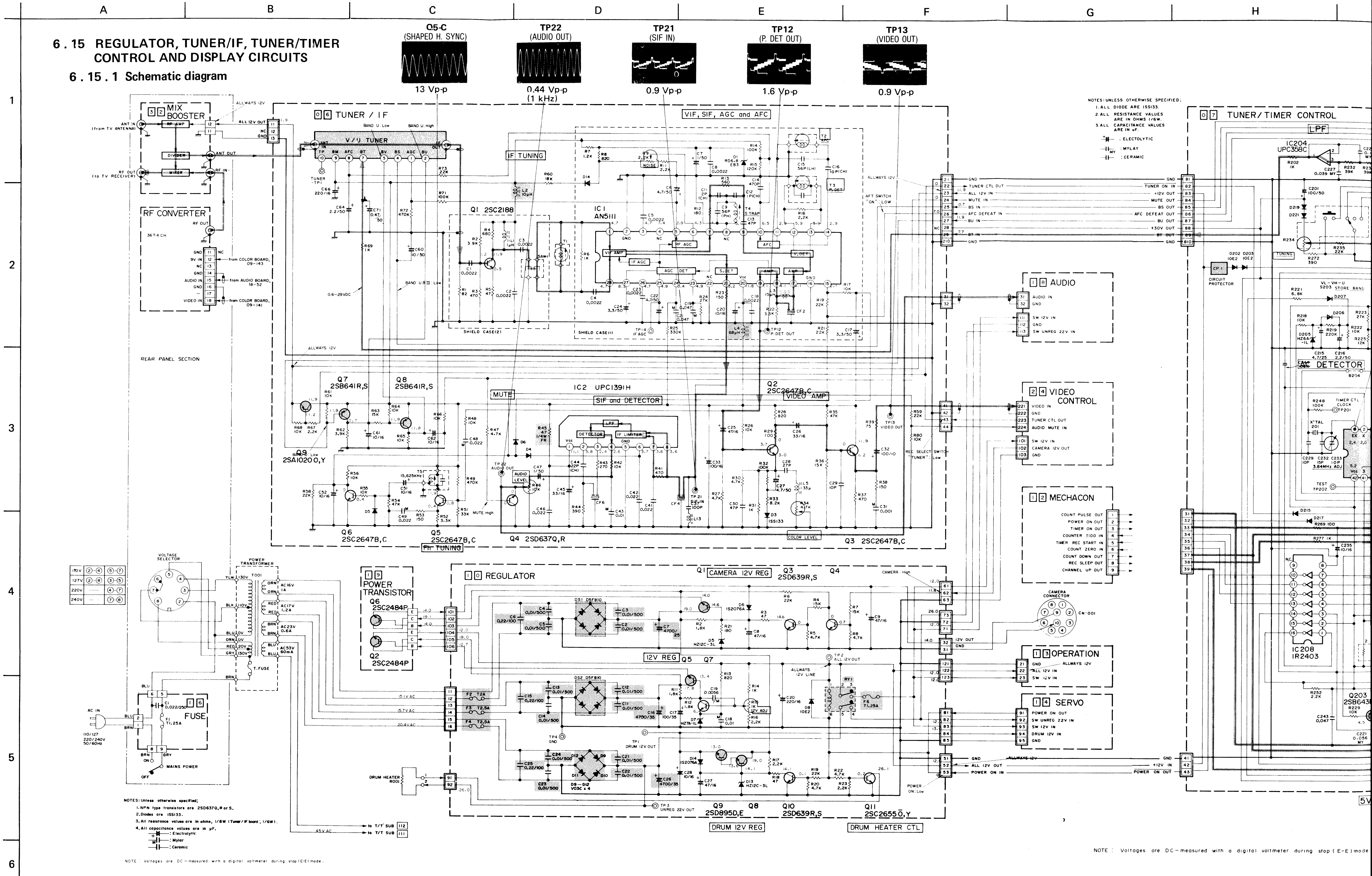

A. ERASE HEAD
A. ERASE HEAD
AUDIO HEAD
AUDIO/CTL HEAD
0 4
REC CURRENT
AUDIO HEAD
AUDIO HEAD
(from SERVO BOARD 14-110)
MIC SWITCH IN
MIC IN
to REAR CONN. BOARD, 27-20)
OUT
IO OUT
IO IN
RD, 06-30)
0 3
FULL ERASE HEAD
FULL ERASE HEAD
(from REGULATOR BOARD, 10-70)
SWITCHED 12V IN
GND
UNREG 22V IN
(from SERVO BOARD, 14-130)
CCIR IN
DOLBY SW IN
(from MECHACON BOARD, 12-40)
CUE CTL. IN
REC START IN
MUTING IN
E-E CTL. IN
AUDIO DUB. IN
PLAY LEVEL
REC LEVEL NTSC
REC LEVEL CCIR
REC EQ NTSC
REC EQ CCIR
REC BIAS
TP12
TP11
TP14
TP13
TP32
TP33
IC2
IC3
IC4
IC5
L1
T1
RY1
Q1
Q2
Q3
Q4
Q5
Q6
Q7
Q8
Q9
Q10
Q11
Q12
Q13
Q14
Q15
Q16
Q17
Q18
Q19
Q20
Q21
Q22
Q23
Q24
R70
R163
R63
R160
R65
R125
44 41
71 73
81 83
91 96
101 104
111 113
12 11

AUDIO SYSTEM LEVEL DIAGRAM (fs: 1KHz, 0dBs = 0.775Vrms)



6 . 15 REGULATOR, TUNER/IF, TUNER/TIMER CONTROL AND DISPLAY CIRCUITS

6 . 15 . 1 Schematic diagram

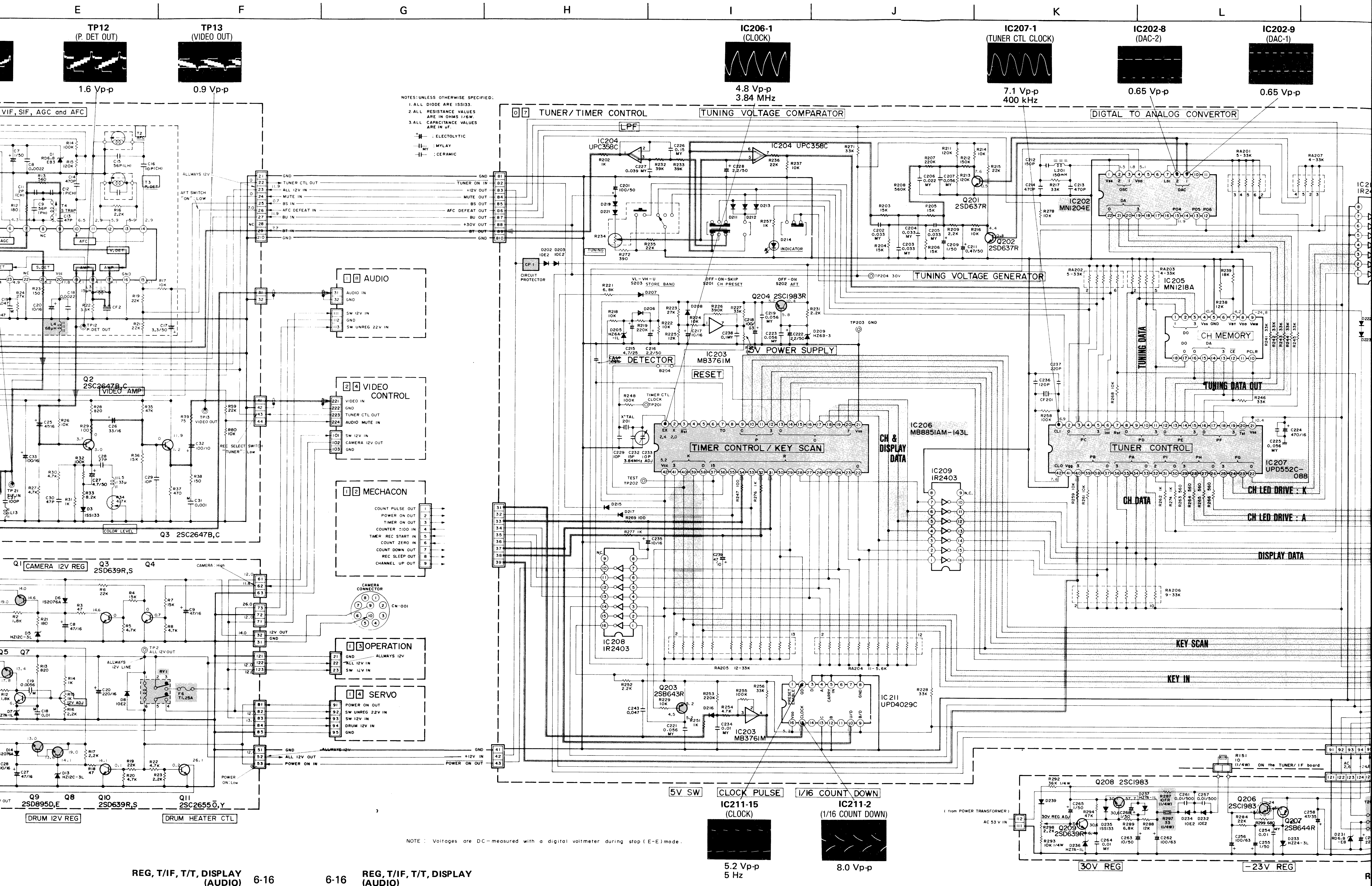

A
B
C
D
E
F
G
H
1
2
3
4
5
6
Q5-C (SHAPED H. SYNC) 13 Vp-p
TP22 (AUDIO OUT) 0.44 Vp-p (1 kHz)
TP21 (SIF IN) 0.9 Vp-p
TP12 (P. DET OUT) 1.6 Vp-p
TP13 (VIDEO OUT) 0.9 Vp-p
32 MIX BOOSTER
RF AMP
DIVIDER
MIXER
ANT IN (from TV ANTENNA)
RF OUT (to TV RECEIVER)
ANT OUT
RF IN
ALLWAYS 12V
RF CONVERTER
36±4 CH
from COLOR BOARD, 09-143
from AUDIO BOARD, 18-52
from COLOR BOARD, 09-141
REAR PANEL SECTION
06 TUNER / IF
V/U TUNER
BAND U: Low
BAND U: High
BAND U.B III : Low
IF TUNING
VIF, SIF, AGC and AFC
IC1 AN5111
VIF AMP
IF AGC
RF AGC
AGC DET
S.DET
AMP
V.DET
AFC
SHIELD CASE(1)
SHIELD CASE(2)
Q1 2SC2188
IC2 UPC1391H
SIF and DETECTOR
MUTE
LPF
DETECTOR
IF LIMITER
VIDEO AMP
Q2 2SC2647B,C
Q3 2SC2647B,C
Q4 2SD637Q,R
Q5 2SC2647B,C
Q6 2SC2647B,C
Q7 2SB641R,S
Q8 2SB641R,S
Q9 2SA1020O,Y
COLOR LEVEL
AUDIO LEVEL
FH TUNING
AFT SWITCH "ON" : Low
REC SELECT SWITCH "TUNER" : Low
VOLTAGE SELECTOR
POWER TRANSFORMER T001
16 FUSE
AC IN 110/127 220/240V 50/60Hz
MAINS POWER
19 POWER TRANSISTOR
Q6 2SC2484P
Q2 2SC2484P
10 REGULATOR
CAMERA 12V REG
Q3 2SD639R,S
12V REG
DRUM 12V REG
DRUM HEATER CTL
Q9 2SD895D,E
Q10 2SD639R,S
Q11 2SC2655O,Y
DRUM HEATER R001
to T/T SUB
45V AC
18 AUDIO
24 VIDEO CONTROL
12 MECHACON
CAMERA CONNECTOR CN-001
13 OPERATION
14 SERVO
07 TUNER/TIMER CONTROL
LPF
IC204 UPC358C
DETECTOR
IC208 IR2403
Q203 2SB643
CIRCUIT PROTECTOR
TUNING
X'TAL 3.84MHz

NOTES: Unless otherwise specified;
1. NPN type transistors are 2SD637Q, R or S.
2. Diodes are 1SS133.
3. All resistance values are in ohms, 1/8W (Tuner/IF board ; 1/6W).
4. All capacitance values are in μF.
: Electrolytic
: Mylar
: Ceramic

NOTE : Voltages are DC-measured with a digital voltmeter during stop (E-E) mode.

NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL DIODE ARE 1SS133.
2. ALL RESISTANCE VALUES ARE IN OHMS 1/6W.
3. ALL CAPACITANCE VALUES ARE IN uF.
: ELECTOLYTIC
: MYLAY
: CERAMIC

NOTE : Voltages are DC-measured with a digital voltmeter during stop (E-E) mode

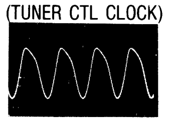

E
F
G
H
I
J
K
L
TP12
(P. DET OUT)
1.6 Vp-p
TP13
(VIDEO OUT)
0.9 Vp-p
IC206-1
(CLOCK)
4.8 Vp-p
3.84 MHz
IC207-1
(TUNER CTL CLOCK)
7.1 Vp-p
400 kHz
IC202-8
(DAC-2)
0.65 Vp-p
IC202-9
(DAC-1)
0.65 Vp-p
VIF, SIF, AGC and AFC
07 TUNER/TIMER CONTROL
TUNING VOLTAGE COMPARATOR
DIGTAL TO ANALOG CONVERTOR
LPF
IC204 UPC358C
IC202 MN1204E
Q201 2SD637R
Q202 2SD637R
TUNING VOLTAGE GENERATOR
IC205 MN1218A
CH MEMORY
TUNING DATA
TUNING DATA OUT
CP1
CIRCUIT PROTECTOR
INDICATOR
TUNING
Q204 2SC1983R
IC203 MB3761M
5V POWER SUPPLY
AC DETECTOR
RESET
IC206 MB8851AM-143L
TIMER CONTROL / KEY SCAN
CH & DISPLAY DATA
IC209 IR2403
IC207 UPD552C-088
TUNER CONTROL
CH DATA
CH LED DRIVE : K
CH LED DRIVE : A
DISPLAY DATA
KEY SCAN
KEY IN
IC208 IR2403
RA205 12-33K
RA204 11-5.6K
RA206 9-33K
Q203 2SB643R
IC203 MB3761M
IC211 UPD4029C
5V SW
CLOCK PULSE
1/16 COUNT DOWN
IC211-15
(CLOCK)
5.2 Vp-p
5 Hz
IC211-2
(1/16 COUNT DOWN)
8.0 Vp-p
18 AUDIO
24 VIDEO CONTROL
12 MECHACON
13 OPERATION
14 SERVO
CAMERA CONNECTOR
CN-001
Q2 2SC2647B,C
VIDEO AMP
Q3 2SC2647B,C
COLOR LEVEL
Q1 CAMERA 12V REG
Q3 2SD639R,S
Q4
Q5
Q7
Q9 2SD895D,E
Q8
Q10 2SD639R,S
Q11 2SC2655O,Y
DRUM 12V REG
DRUM HEATER CTL
RY1
F6 T1.25A
Q208 2SC1983
Q209 2SD639R
30V REG
Q206 2SC1983
Q207 2SB644R
-23V REG
AC 53 V IN
ON the TUNER/ IF board

NOTES: UNLESS OTHERWISE SPECIFIED;
1. ALL DIODE ARE 1SS133.
2. ALL RESISTANCE VALUES ARE IN OHMS 1/6W.
3. ALL CAPACITANCE VALUES ARE IN uF.
: ELECTOLYTIC
MY : MYLAY
: CERAMIC

NOTE : Voltages are DC-measured with a digital voltmeter during stop (E-E) mode.

J K L M N O P Q R

IC207-1
(TUNER CTL CLOCK)

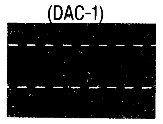


7.1 Vp-p
400 kHz

IC202-8
(DAC-2)

0.65 Vp-p

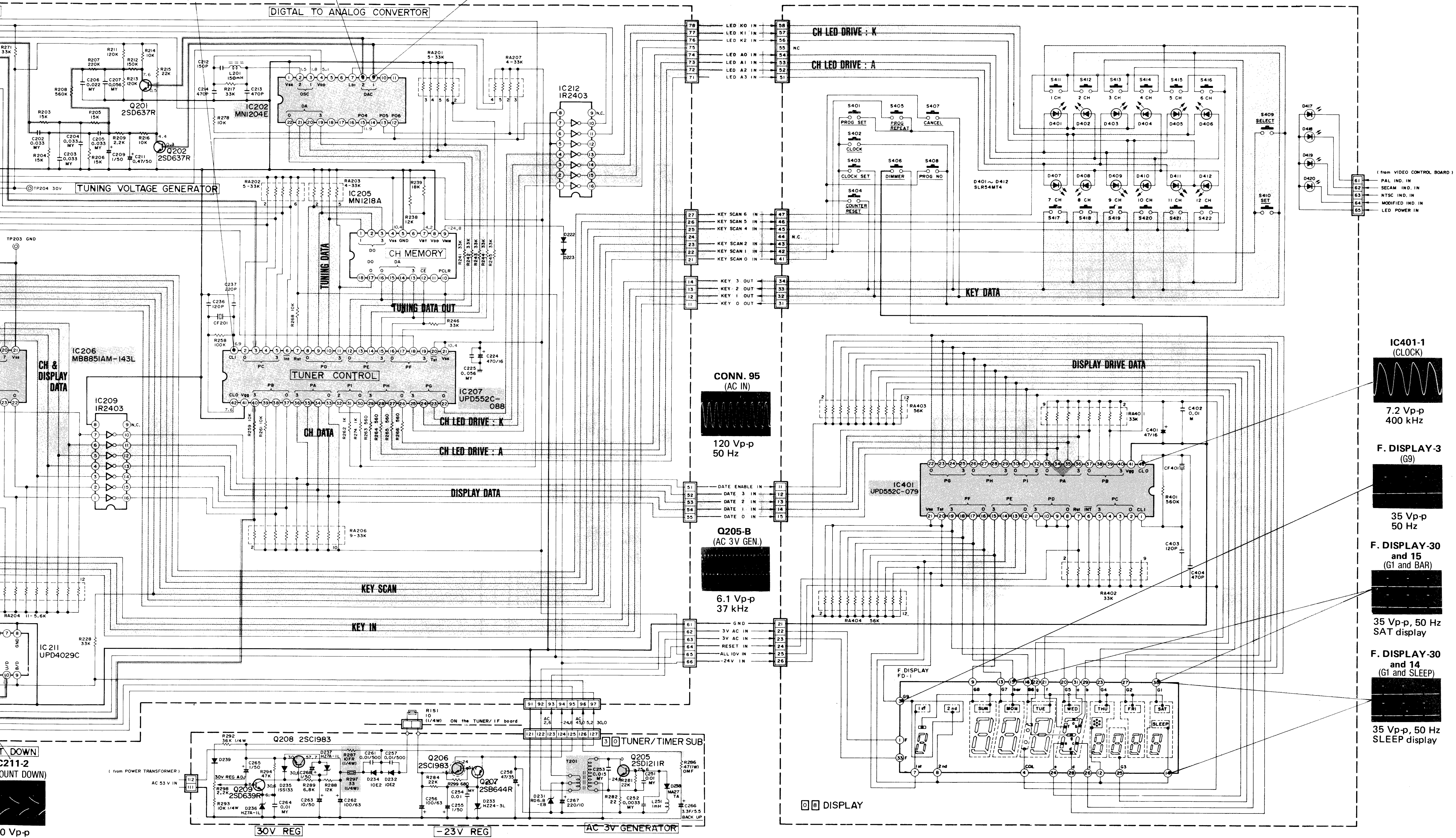
IC202-9
(DAC-1)



0.65 Vp-p

NOTES: 1. Voltages are DC-measured with a digital voltmeter during PAL recording mode.
2. Where voltage differs between recording and playback, the voltage during playback mode

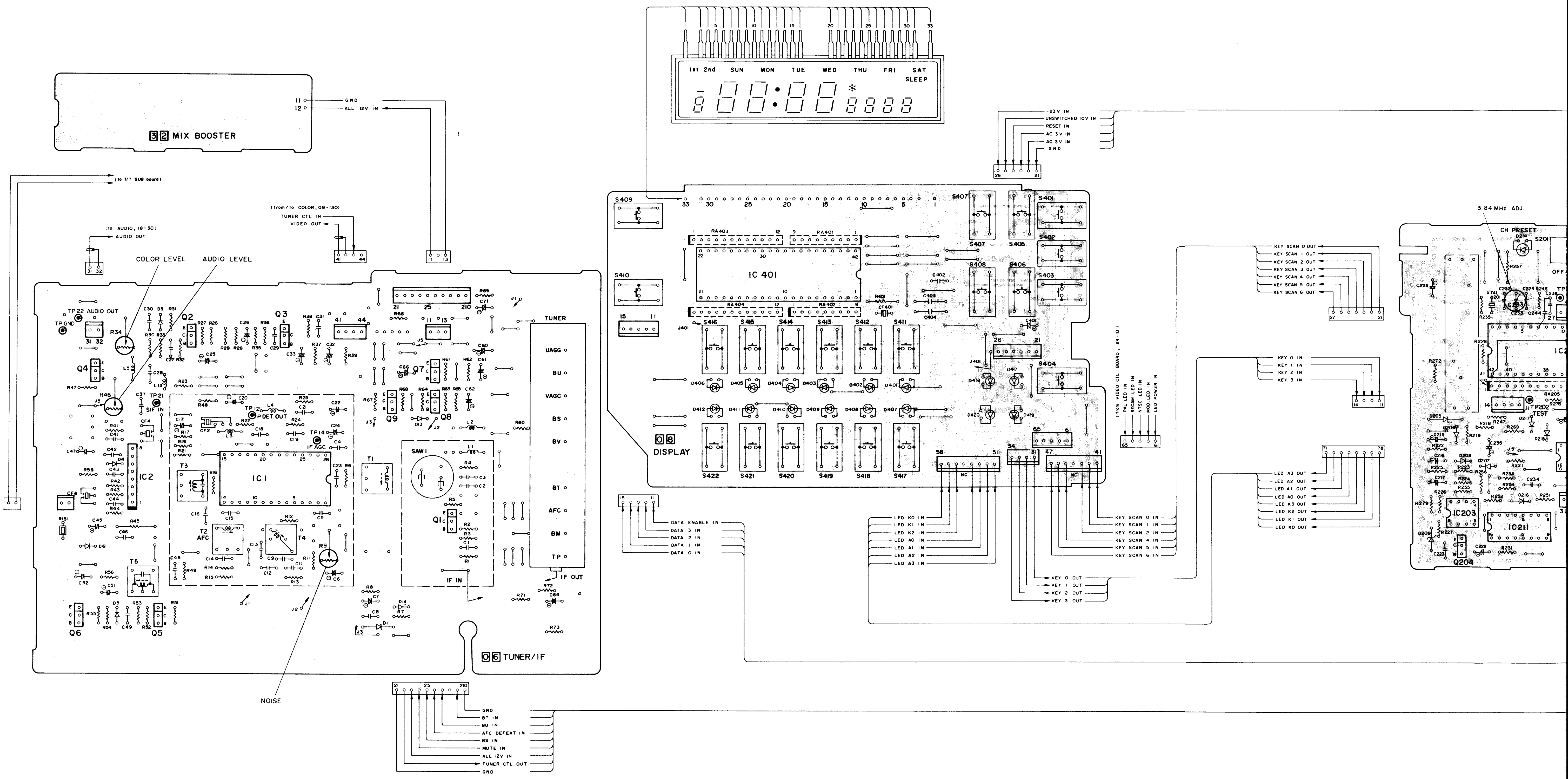
NOTE: When not specified, waveform is PAL recording or E-E mode.



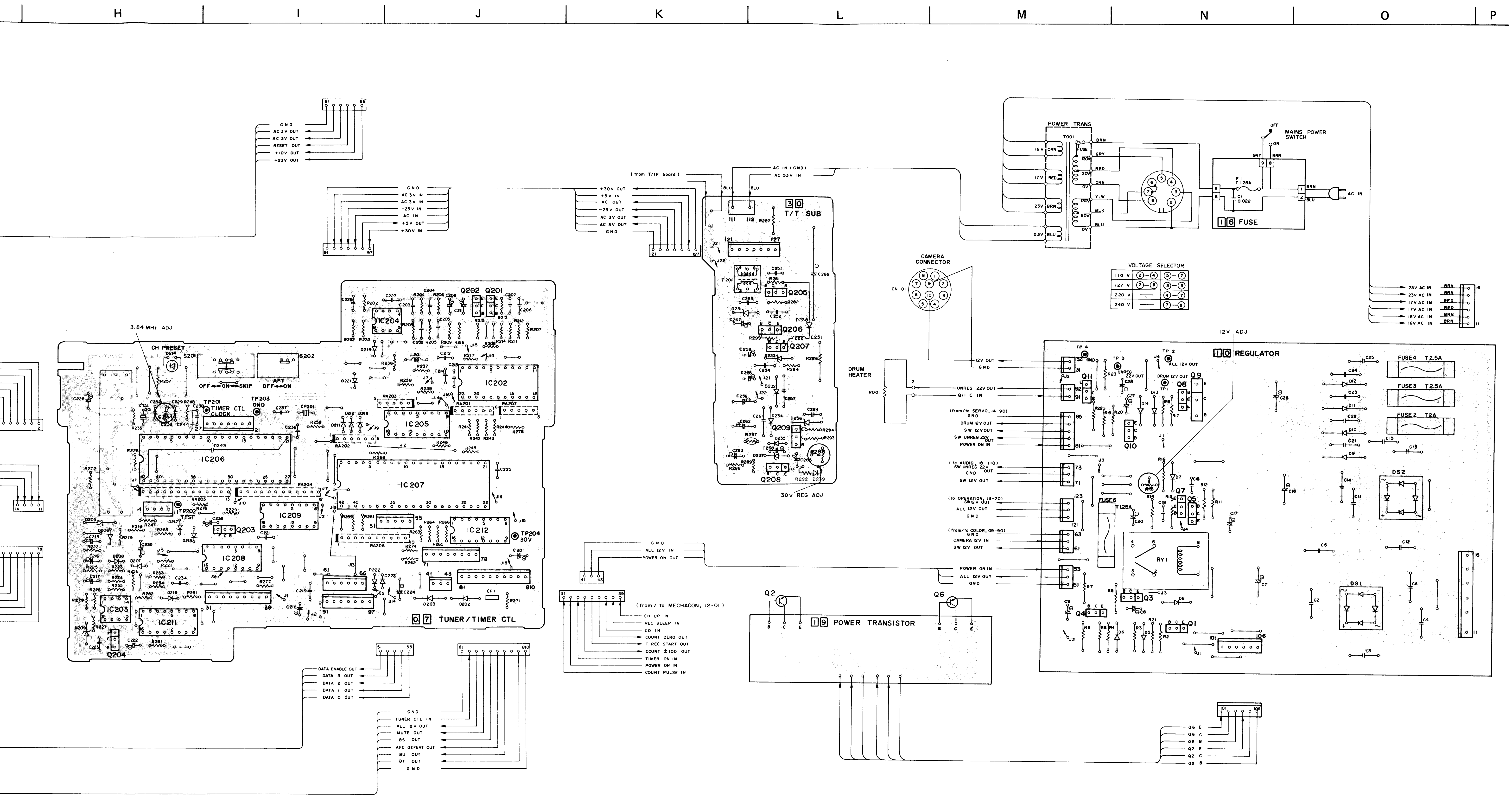
DIGTAL TO ANALOG CONVERTOR
TUNING VOLTAGE GENERATOR
IC202 MN1204E
Q201 2SD637R
Q202 2SD637R
IC205 MN1218A
CH MEMORY
TUNING DATA
TUNING DATA OUT
IC212 IR2403
IC206 MB8851AM-143L
CH & DISPLAY DATA
IC209 IR2403
TUNER CONTROL
IC207 UPD552C-088
CH DATA
CH LED DRIVE : K
CH LED DRIVE : A
DISPLAY DATA
KEY SCAN
KEY IN
IC 211 UPD4029C
T DOWN
C211-2
OUNT DOWN)
0 Vp-p
LED K0 IN
LED K1 IN
LED K2 IN
LED A0 IN
LED A1 IN
LED A2 IN
LED A3 IN
KEY SCAN 6 IN
KEY SCAN 5 IN
KEY SCAN 4 IN
KEY SCAN 2 IN
KEY SCAN 1 IN
KEY SCAN 0 IN
KEY 3 OUT
KEY 2 OUT
KEY 1 OUT
KEY 0 OUT
DATE ENABLE IN
DATE 3 IN
DATE 2 IN
DATE 1 IN
DATE 0 IN
GND
3V AC IN
3V AC IN
RESET IN
ALL 10V IN
-24V IN
CONN. 95
(AC IN)
120 Vp-p
50 Hz
Q205-B
(AC 3V GEN.)
6.1 Vp-p
37 kHz
R151 10 (1/4W) ON the TUNER/IF board
30V REG
-23V REG
AC 3V GENERATOR
Q208 2SC1983
Q209 2SD639R
Q206 2SC1983
Q207 2SB644R
Q205 2SD1211R
T201
(from POWER TRANSFORMER)
AC 53 V IN
3 0 TUNER/TIMER SUB
CH LED DRIVE : K
CH LED DRIVE : A
S401 PROG SET
S405 PROG REPEAT
S407 CANCEL
S402 CLOCK
S403 CLOCK SET
S406 DIMMER
S408 PROG NO
S404 COUNTER RESET
S409 SELECT
S410 SET
S411 1 CH
S412 2 CH
S413 3 CH
S414 4 CH
S415 5 CH
S416 6 CH
S417 7 CH
S418 8 CH
S419 9 CH
S420 10 CH
S421 11 CH
S422 12 CH
D401～D412 SLR54MT4
KEY DATA
DISPLAY DRIVE DATA
IC401 UPD552C-079
(from VIDEO CONTROL BOARD)
PAL IND. IN
SECAM IND. IN
NTSC IND. IN
MODIFIED IND. IN
LED POWER IN
F DISPLAY FD-1
1st 2nd SUN MON TUE WED THU FRI SAT SLEEP
0 8 DISPLAY
IC401-1
(CLOCK)
7.2 Vp-p
400 kHz
F. DISPLAY-3
(G9)
35 Vp-p
50 Hz
F. DISPLAY-30
and 15
(G1 and BAR)
35 Vp-p, 50 Hz
SAT display
F. DISPLAY-30
and 14
(G1 and SLEEP)
35 Vp-p, 50 Hz
SLEEP display

6-16 REG, T/IF, T/T, DISPLAY (AUDIO)

6 . 15 . 2 Circuit board

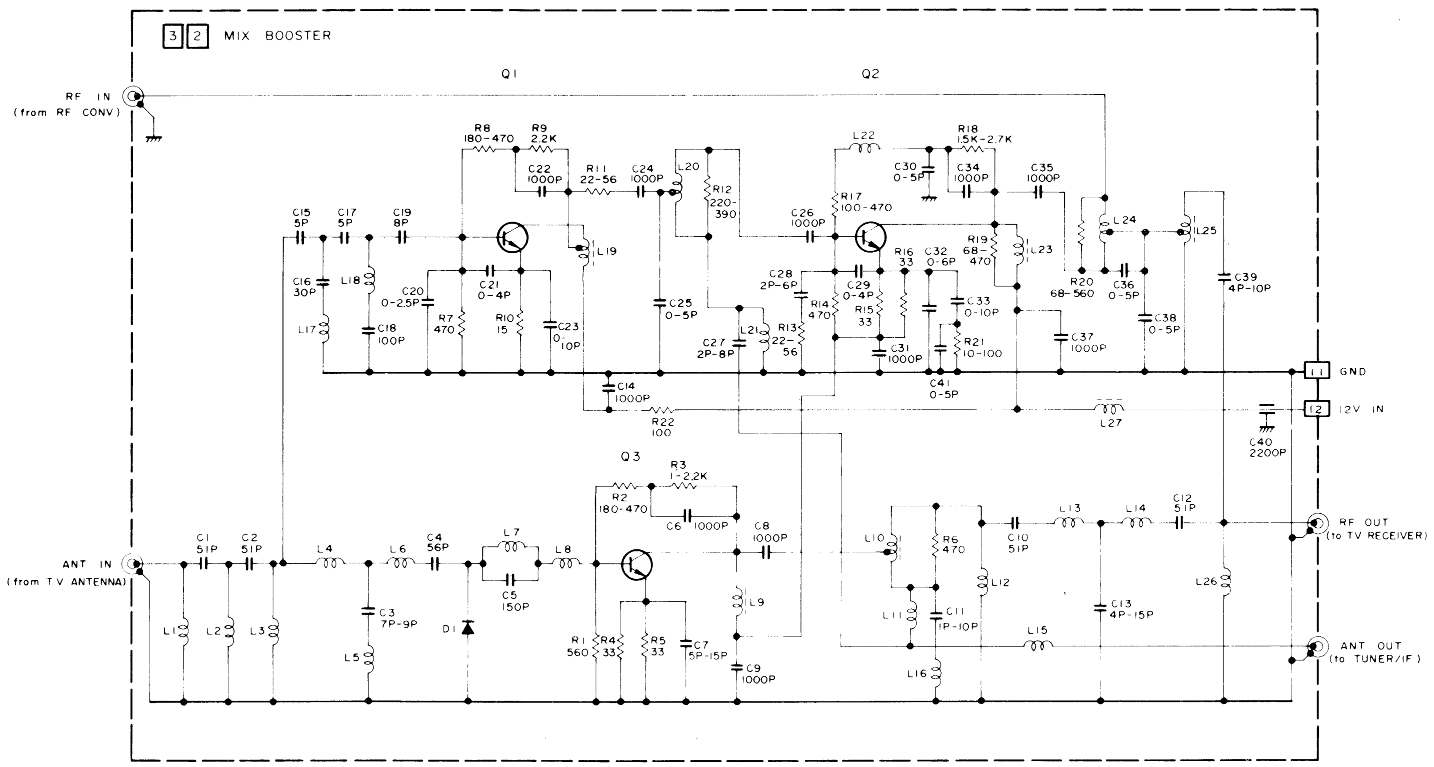


32 MIX BOOSTER
GND
ALL 12V IN
(to T/T SUB board)
(to AUDIO, 18-30)
AUDIO OUT
(from/to COLOR, 09-130)
TUNER CTL IN
VIDEO OUT
COLOR LEVEL
AUDIO LEVEL
TP22 AUDIO OUT
TP GND
TP21 SIF IN
TP12 P DET OUT
TP14 IF AGC
IC1
IC2
T1
T2 AFC
T3
T4
T5
SAW1
TUNER
UAGG
BU
VAGC
BS
BV
BT
AFC
BM
TP
IF OUT
IF IN
NOISE
06 TUNER/IF
BT IN
BU IN
AFC DEFEAT IN
BS IN
MUTE IN
TUNER CTL OUT
1st 2nd SUN MON TUE WED THU FRI SAT SLEEP
IC 401
08 DISPLAY
-23V IN
UNSWITCHED 10V IN
RESET IN
AC 3V IN
DATA ENABLE IN
DATA 3 IN
DATA 2 IN
DATA 1 IN
DATA 0 IN
LED K0 IN
LED K1 IN
LED K2 IN
LED A0 IN
LED A1 IN
LED A2 IN
LED A3 IN
KEY SCAN 0 IN
KEY SCAN 1 IN
KEY SCAN 2 IN
KEY SCAN 3 IN
KEY SCAN 4 IN
KEY SCAN 5 IN
KEY SCAN 6 IN
KEY 0 OUT
KEY 1 OUT
KEY 2 OUT
KEY 3 OUT
KEY SCAN 0 OUT
KEY SCAN 1 OUT
KEY SCAN 2 OUT
KEY SCAN 3 OUT
KEY SCAN 4 OUT
KEY SCAN 5 OUT
KEY SCAN 6 OUT
KEY 0 IN
KEY 1 IN
KEY 2 IN
KEY 3 IN
(from VIDEO CTL BOARD, 24-10)
PAL LED IN
SECAM LED IN
NTSC LED IN
MOD LED IN
LED POWER IN
LED A3 OUT
LED A2 OUT
LED A1 OUT
LED A0 OUT
LED K3 OUT
LED K2 OUT
LED K1 OUT
LED K0 OUT
3.84 MHz ADJ.
CH PRESET
IC203
IC211
Q204
TP202 TEST


H
I
J
K
L
M
N
O
P
GND
AC 3V OUT
AC 3V OUT
RESET OUT
+10V OUT
+23V OUT
GND
AC 3V IN
AC 3V IN
-23V IN
AC IN
+5V OUT
+30V IN
+30V OUT
+5V IN
AC OUT
-23V OUT
AC 3V OUT
AC 3V OUT
GND
(from T/IF board)
AC IN (GND)
AC 53V IN
BLU
30 T/T SUB
T201
Q205
Q206
Q207
Q208
Q209
30V REG ADJ
3.84 MHz ADJ.
CH PRESET
S201
S202
OFF — ON — SKIP
AFT OFF — ON
TP201 TIMER CTL. CLOCK
TP203 GND
TP202 TEST
TP204 30V
IC202
IC203
IC204
IC205
IC206
IC207
IC208
IC209
IC211
IC212
Q201
Q202
Q203
Q204
07 TUNER/TIMER CTL
GND
ALL 12V IN
POWER ON OUT
(from/to MECHACON, 12-01)
CH UP IN
REC SLEEP IN
CD IN
COUNT ZERO OUT
T.REC START OUT
COUNT ±100 OUT
TIMER ON IN
POWER ON IN
COUNT PULSE IN
DATA ENABLE OUT
DATA 3 OUT
DATA 2 OUT
DATA 1 OUT
DATA 0 OUT
GND
TUNER CTL IN
ALL 12V OUT
MUTE OUT
BS OUT
AFC DEFEAT OUT
BU OUT
BT OUT
GND
CAMERA CONNECTOR
CN-01
DRUM HEATER
R001
19 POWER TRANSISTOR
Q2
Q6
POWER TRANS
T001
16V ORN
17V RED
23V BRN
53V BLU
MAINS POWER SWITCH
OFF
ON
F1 T1.25A
C1 0.022
16 FUSE
AC IN
VOLTAGE SELECTOR
110 V ②-④ ⑤-⑦
127 V ②-⑥ ③-⑤
220 V — ④-⑦
240 V — ⑦-⑧
23V AC IN
23V AC IN
17V AC IN
17V AC IN
16V AC IN
16V AC IN
12V ADJ
10 REGULATOR
12V OUT
GND
UNREG 22V OUT
Q11 C IN
(from/to SERVO, 14-90)
GND
DRUM 12V OUT
SW 12V OUT
SW UNREG 22V OUT
POWER ON IN
(to AUDIO, 18-110)
SW UNREG 22V OUT
GND
SW 12V OUT
(to OPERATION, 13-20)
SW12V OUT
ALL 12V OUT
GND
(from/to COLOR, 09-90)
GND
CAMERA 12V IN
SW 12V OUT
POWER ON IN
ALL 12V OUT
GND
TP1
TP2 ALL 12V OUT
TP3 UNREG 22V OUT
TP4 GND
DRUM 12V OUT
FUSE4 T2.5A
FUSE3 T2.5A
FUSE2 T2A
FUSE6 T125A
RY1
DS1
DS2
Q6 E
Q6 C
Q6 B
Q2 E
Q2 C
Q2 B

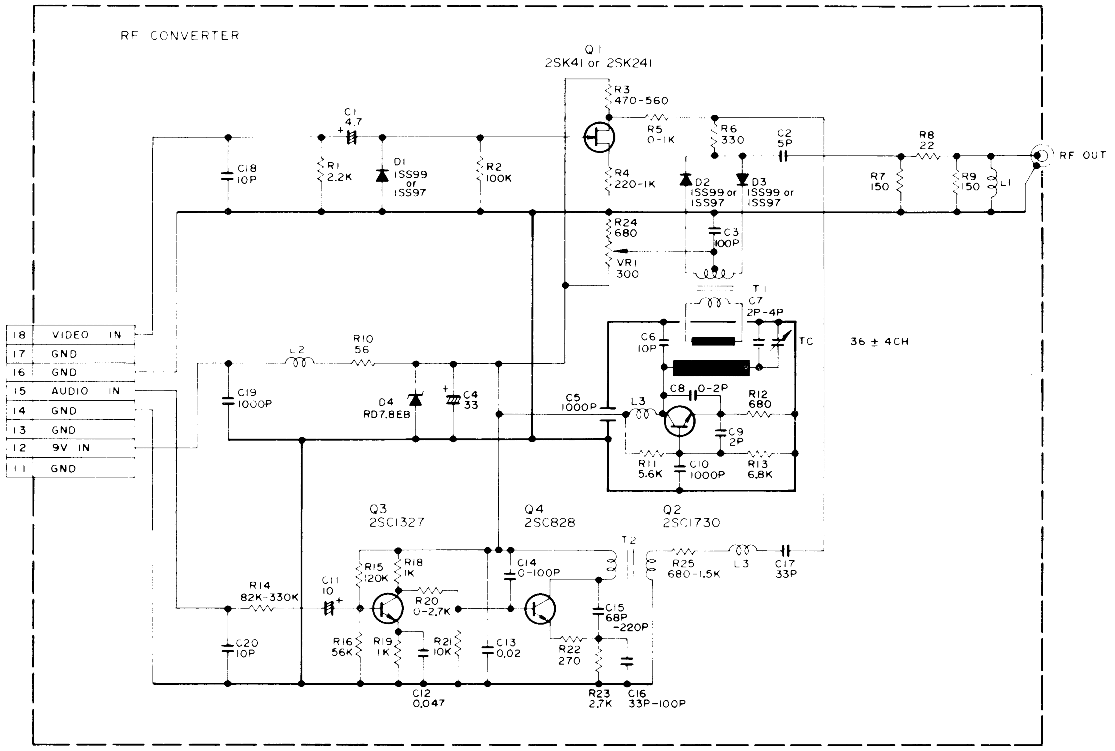
6 . 16 MIX BOOSTER, RF CONVERTER, V/U TUNER AND WIREELESS REMOTE CONTROL UNIT SCHEMATIC DIAGRAMS (reference)

– MIX BOOSTER –

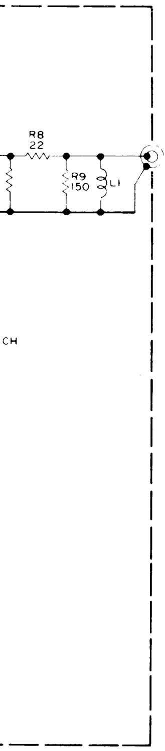

3 2 MIX BOOSTER
RF IN (from RF CONV)
ANT IN (from T.V ANTENNA)
Q1
Q2
Q3
R8 180-470
R9 2.2K
C22 1000P
R11 22-56
C24 1000P
L20
R12 220-390
L19
L22
C30 0-5P
R18 1.5K-2.7K
C34 1000P
C35 1000P
C26 1000P
R17 100-470
R16 33
C32 0-6P
R19 68-470
L23
L24
L25
R20 68-560
C36 0-5P
C39 4P-10P
C15 5P
C17 5P
C19 8P
C16 30P
L18
L17
C18 100P
C20 0-2.5P
R7 470
C21 0-4P
R10 15
C23 0-10P
C25 0-5P
C28 2P-6P
C27 2P-8P
L21
R14 470
R13 22-56
C29 0-4P
R15 33
C31 1000P
C33 0-10P
R21 10-100
C41 0-5P
C37 1000P
C38 0-5P
C14 1000P
R22 100
L27
C40 2200P
11 GND
12 12V IN
R3 1-2.2K
R2 180-470
C6 1000P
C8 1000P
C1 51P
C2 51P
L4
L6
C4 56P
L7
L8
C5 150P
L1
L2
L3
C3 7P-9P
L5
D1
R1 560
R4 33
R5 33
C7 5P-15P
L9
C9 1000P
L10
R6 470
C10 51P
L13
L14
C12 51P
L11
C11 1P-10P
L12
L16
L15
C13 4P-15P
L26
RF OUT (to TV RECEIVER)
ANT OUT (to TUNER/IF)

NOTES : Unless otherwise specified ,
1 All transistors are 2SC2570A.
2 All diodes are 1S2076 or 1S2473.
3 All resistance values are in ohms.

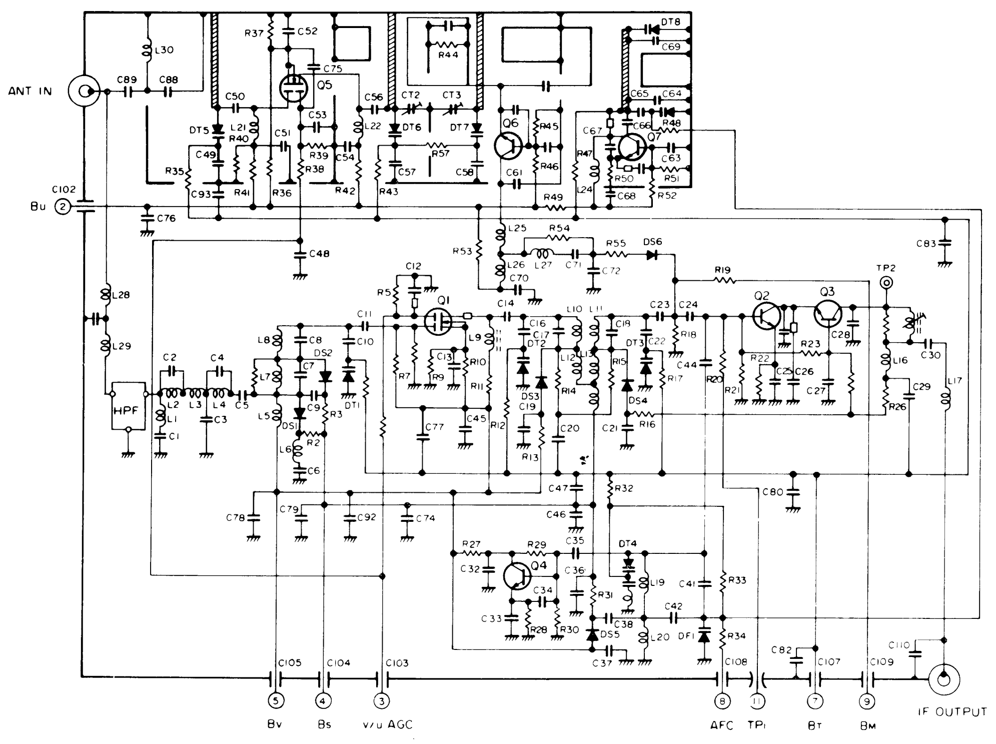
– RF CONVERTER –


RF CONVERTER
Q1 2SK41 or 2SK241
C1 4.7
R3 470-560
R5 0-1K
R6 330
C2 5P
R8 22
RF OUT
C18 10P
R1 2.2K
D1 1SS99 or 1SS97
R2 100K
R4 220-1K
D2 1SS99 or 1SS97
D3 1SS99 or 1SS97
R7 150
R9 150
L1
R24 680
C3 100P
VR1 300
T1
C7 2P-4P
TC
36 ± 4CH
18 VIDEO IN
17 GND
16 GND
15 AUDIO IN
14 GND
13 GND
12 9V IN
11 GND
L2
R10 56
C19 1000P
D4 RD7.8EB
C4 33
C6 10P
C5 1000P
L3
C8 0-2P
R12 680
C9 2P
R11 5.6K
C10 1000P
R13 6.8K
Q3 2SC1327
Q4 2SC828
Q2 2SC1730
T2
R25 680-1.5K
L3
C17 33P
R14 82K-330K
C11 10
R15 120K
R18 1K
C14 0-100P
R20 0-2.7K
C15 68P-220P
C20 10P
R16 56K
R19 1K
R21 10K
C13 0.02
R22 270
C12 0.047
R23 2.7K
C16 33P-100P

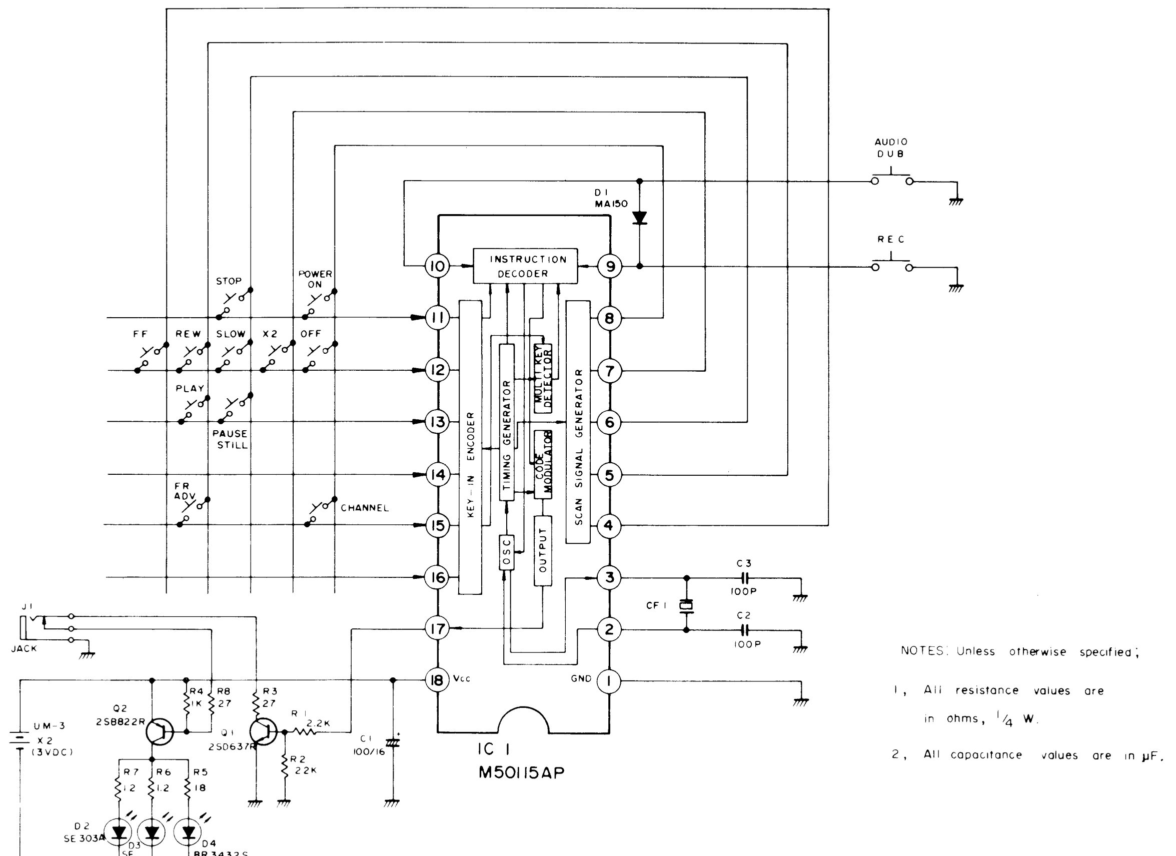
NOTES : Unless otherwise specified ;
1 All resistance values are in ohms.
2 All capacitance values are in μF.


R8
22
R9
150
L1
RF OUT
CH

— V/U TUNER SCHEMATIC DIAGRAM —


ANT IN
Bu ②
C102
HPF
Q1
Q2
Q3
Q4
Q5
Q6
Q7
TP2
⑤ Bv
④ Bs
③ v/u AGC
⑧ AFC
⑪ TPi
⑦ BT
⑨ BM
IF OUTPUT

— WIRELESS REMOTE CONTROL UNIT —


AUDIO DUB
REC
D1 MA150
INSTRUCTION DECODER
KEY-IN ENCODER
TIMING GENERATOR
MULTI KEY DETECTOR
CODE MODULATOR
SCAN SIGNAL GENERATOR
OSC
OUTPUT
STOP
POWER ON
FF
REW
SLOW
X2
OFF
PLAY
PAUSE STILL
FR ADV
CHANNEL
C3 100P
C2 100P
CF1
GND
Vcc
IC 1
M50115AP
J1
JACK
UM-3 X2 (3VDC)
Q2 2SB822R
Q1 2SD637R
R4 1K
R8 27
R3 27
R1 2.2K
R2 2.2K
C1 100/16
R7 1.2
R6 1.2
R5 18
D2 SE303A
D3 SE303A
D4 BR3432S

NOTES: Unless otherwise specified;

1. All resistance values are in ohms, ¼ W.

2. All capacitance values are in μF.

SECTION 7
EXPLODED VIEWS AND PARTS LIST

SAFETY PRECAUTION

Parts identified by the ⚠ symbol are critical for safety.
Replace only with specified part numbers.

7.1 STANDARD PART NUMBER CODING

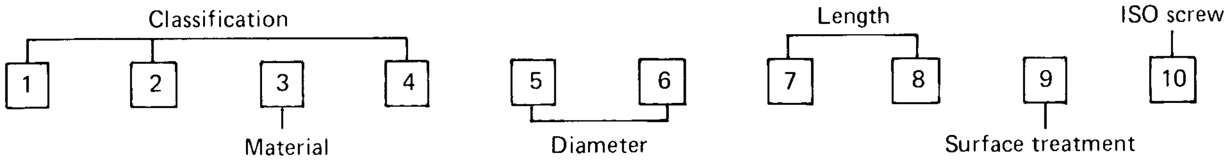
7.1.1 Screw coding 7-2
7.1.2 Fuse coding 7-3

7.2 EXPLODED VIEWS AND PARTS LIST

7.2.1 Packing assembly 7-3
7.2.2 Cabinet assembly 7-4
7.2.3 Chassis assembly 7-5
7.2.4 Power transformer assembly 7-5
7.2.5 Main deck assembly 7-6
7.2.6 Sub deck and drum assemblies 7-10
7.2.7 Cassette housing assembly 7-12
7.2.8 Remote control unit 7-14

7.1 STANDARD PART NUMBER CODING

7.1.1 Screw coding



Classification (first digit)

Symbol Letter	Name
S	Normal screw
N	Assembly screw
L	"
D	"
M	Wood screw
F	Feather screw
T	Set screw
Y	"
B	Bolt
N	Nut
W	Washer
R	E-ring
E	Eyelet
P	Spring
G	Washer head screw

Material (third digit)

Symbol Letter	Material
S	Steel
E	Stainless steel
C	Cast iron
U	Bronze
B	Brass
P	Phosphor bronze
N	German silver
Y	Brass
A	Aluminum
Z	Zinc alloy
K	Polycarbonate

Surface Treatment (ninth digit)

Symbol Letter	Surface Treatment
Z	Galvanization, dichromic acid treatment (MFZn2-C)
N	Nickel plating (MFNi2, MFNil)
R	Chrome plating (MBCr2, MBCr1)
G	Silver plating (SP4)
W	Nichrome platings
P	Phosphite treatment
B	Bronze plating
M	Black coloring after galvanization
A	Red coloring after galvanization
C	Blue coloring after galvanization
T	Green coloring after galvanization
V	Violet coloring after galvanization
F	Iron with black coloring

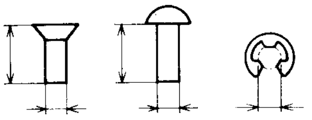
Shape of Screw Head (second digit)

Symbol Letter		Shape of Screw Head
P		Pan head
S		Flat countersunk head
H		Oval countersunk head
D		Binding head
R		Round head
B		Round head
T		Truss head

Type of Screw (fourth digit)

Symbol Letter	Type of Screw
P	Cross-Recessed head screw
A	Tapping screw
B	Special tapping screw
T	Special tapping screw
E	Special tapping screw
F	Special tapping screw

Diameter and Length of Screw (fifth – eighth digit)

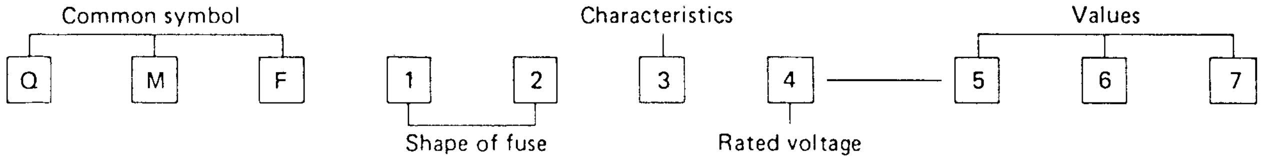


– Example –

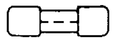
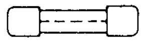
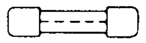
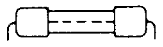
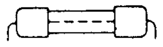
$\text{S P B P }\underbrace{\text{3 0}}_{\text{(Diameter x 10)}}\;\underbrace{\text{0 6}}_{\text{(Length)}}\text{ Z S}$

Diameter : 3 mm
Length : 6 mm

7.1.2 Fuse coding



Shape of Fuse (first and second digit)

Symbol No.	Shape	Remarks
51		φ 5.2 x 20
60		φ 6.4 x 30
61		φ 6.35 x 31.8
63		With 60 Lead Wire
66		With 61 Lead Wire

Rated Voltage (fourth digit)

Symbol No.	Rated Voltage	
1	AC 125 V	
2	AC 250 V	
3	100 mA ~ 1 A	AC 250 V
	1.25 A ~ 6.3 A	AC125 V

Values (fifh-seventh digit)

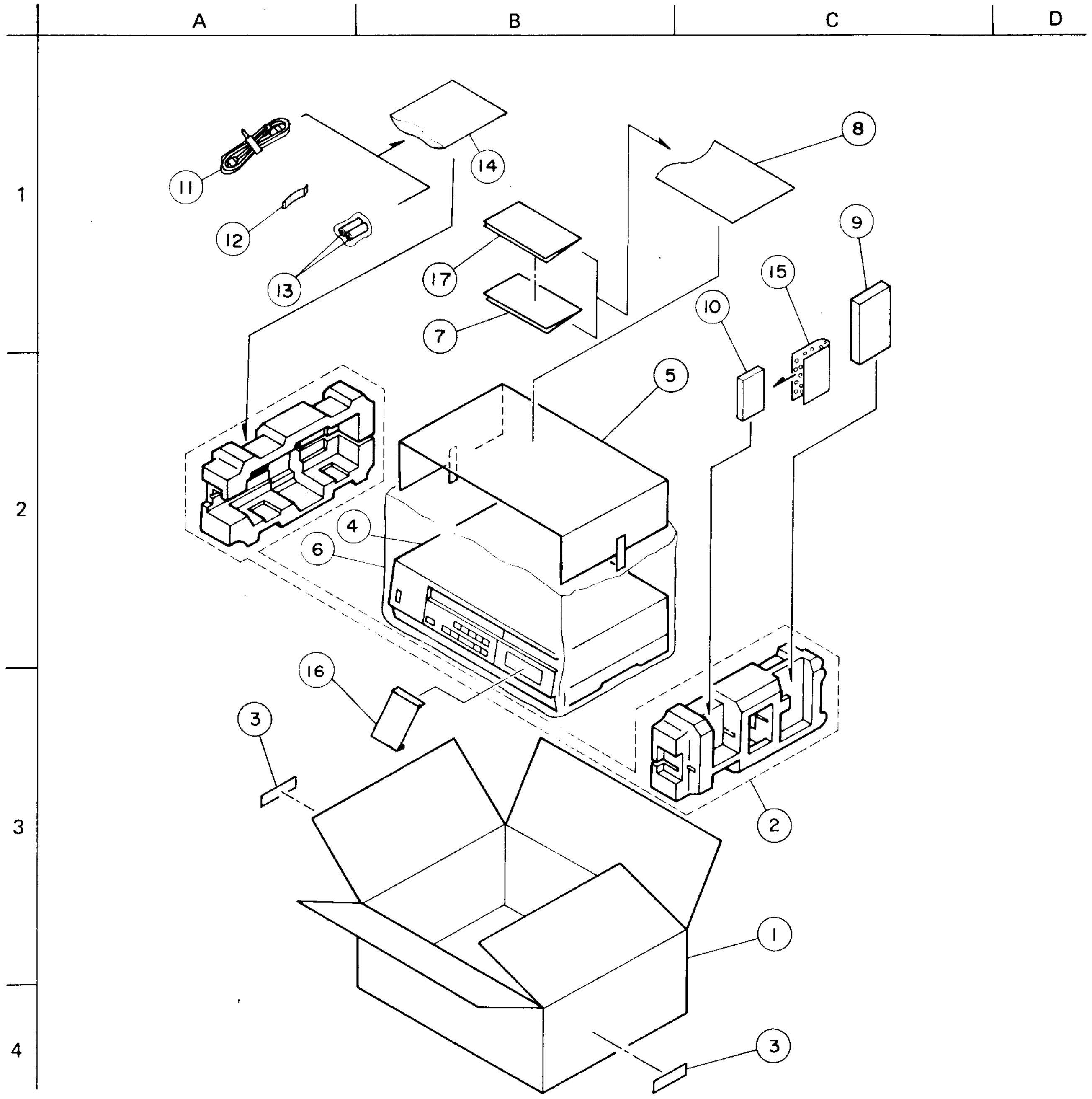
R10	100 mA
R125	125 mA
1R0	1.0 A
1R2	1.2 A
1R25	1.25 A
100	10 A

Characteristics (third digit)

Symbol No.	Fusing Current	Fusing Time	Remarks
S	160%	Within 1 hr.	Anti-rush Type
	200%	〃 2 min.	
	700% – 2000%	〃 0.01 sec.	
R	160%	〃 1 hr.	Regular Fusible Type
	200%	〃 2 min.	
M	135%	〃 1 hr.	Regular Fusible Type (for UL)
	200%	〃 2 min.	
U	135%	〃 1 hr.	Anti-rush Type (for UL)
	200%	〃 2 min.	
	800% – 2000%	〃 0.01 sec.	
A	210%	〃 2 min.	Anti-rush Type (for Europe)
	275%	0.5 – 10 sec.	
	400%	0.15 – 2 sec.	
	1000%	0.02 – 0.3 sec.	
B	210%	Within 30 min.	Regular Fusible Type (for SEMKO, Europe)
	275%	0.05 – 2 sec.	
	400%	0.01 – 0.3 sec.	
C	135%	Within 1 hr.	Anti-rush Type (for UL, Japan)
	200%	〃 2 min.	

7.2 EXPLODED VIEWS AND PARTS LIST

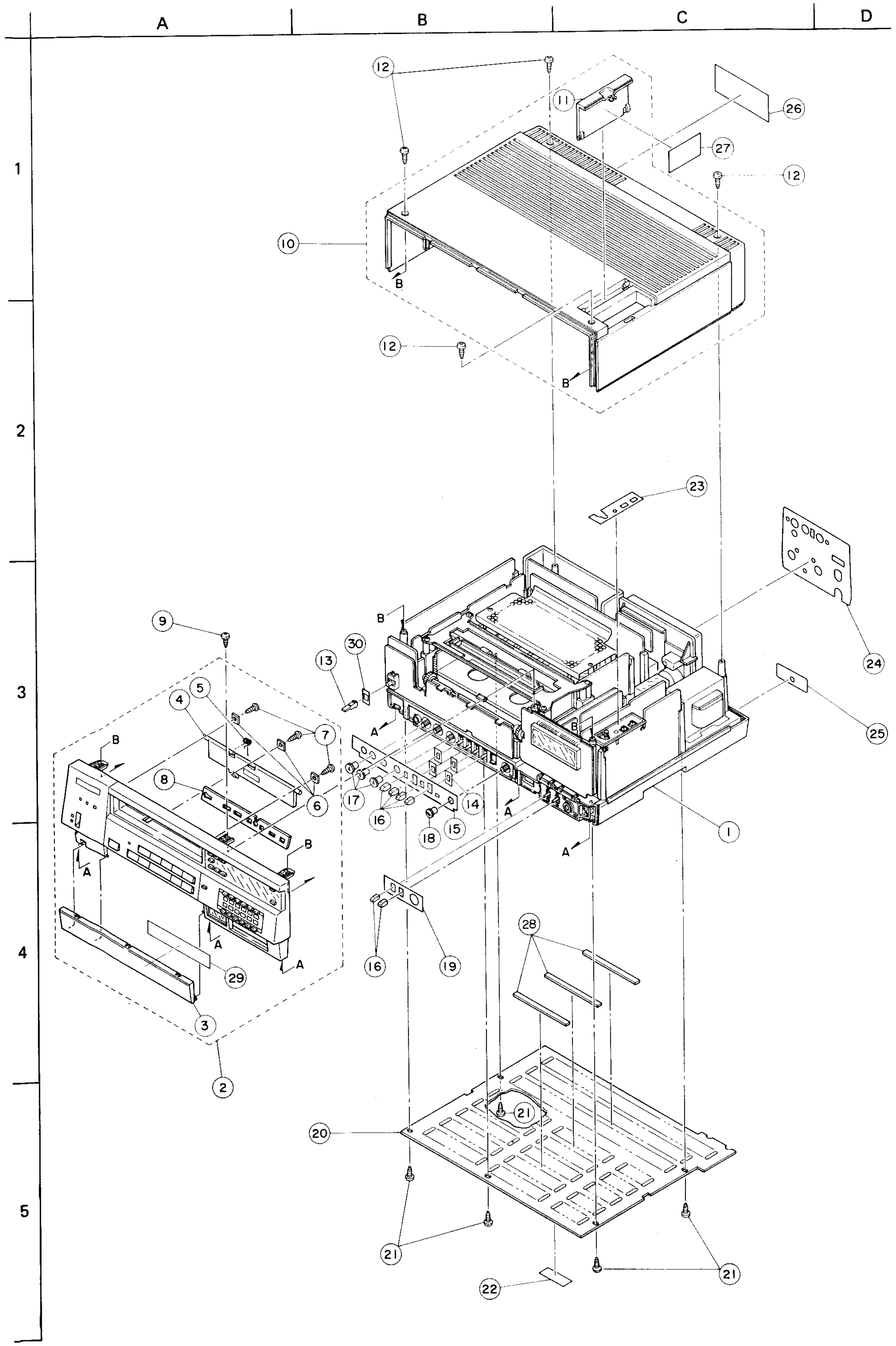
7.2.1 Packing assembly



— Packing assembly list —

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
1	PUP30522-47	Packing Case		3-C	1
2	PUP30518A-1	Cushion Assembly		3-C	1
3	PUP40329	Serial No. Sticker		3-A, 4-C	2
4	—	Cabinet Assembly	See Section 7.2.2	2-B	1
5	PUP40503-4	Sheet		2-B	1
6	PUM30021-20	Poly Cover		2-A	1
⚠ 7	PU30425-487	Instruction Book		1-B	1
8	QPGA025-03505	Poly Bag		1-C	1
9	PTE-30	Video Cassette		1-C	1
10	—	Remoto Control Unit	See Section 7.2.8	1-C	1
⚠ 11	PU43294K	Aerial Cable Assembly		1-A	1
12	PU52523	Hook		1-A	1
13	UM-3DJ2P	Battery		1-A	2
14	QPGA023-02005	Poly Bag		1-B	1
15	PUP40003-11	Air Cap		1-C	1
16	PU33747	Tag		2-A	1
⚠ 17	PU30425-504	Instruction Book		1-B	1

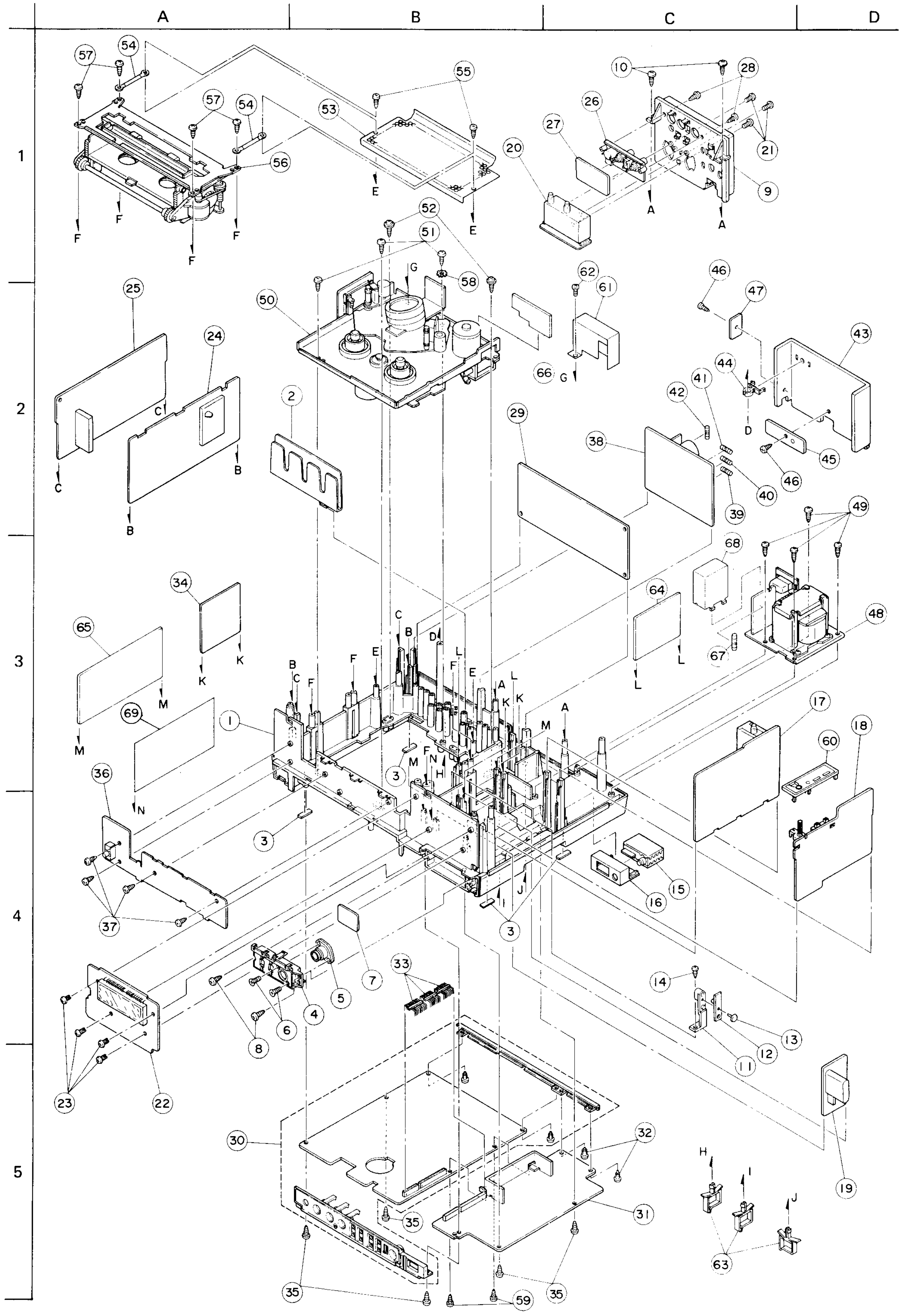
7.2.2 Cabinet assembly



– Cabinet assembly list –

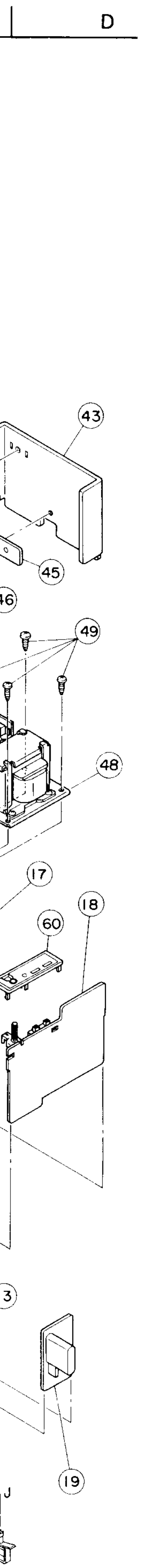
Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
1	–	Chassis Assembly	See Section 7.2.3	4-C	1
⚠ 2	PU10396J	Front Panel Assembly		5-A	1
3	PU21206	Door		4-A	1
4	PU33080R	Cassette Plate Assembly		3-A	1
5	PU51553	Spring		3-A	1
6	PU51552	Stopper		3-B	3
7	SDSA2610Z	Tapping Screw		3-B	3
8	PU52594-1-3	Shade (2)		3-A	1
9	SDSA4016R	Tapping Screw		3-A	1
⚠ 10	PU10565T	Top Cover Assembly		1-A	1
11	PU33071-14	Door		1-C	1
12	SDSA4016R	Tapping Screw		1-B, C, 2-B	4
13	PU51539	Knob		3-B	1
14	PU51917-1-3	Plate		3-B	4
15	PU33078-2	Control Plate		4-B	1
16	PU51567	Knob		4-B	6
17	PU51940	"		3-B	3
18	PU51939	"		4-B	1
19	PU53879-2	Control Plate		4-B	1
⚠ 20	PU10427	Bottom Plate		5-B	1
21	SDSA3012Z	Tapping Screw		5-B, C	5
22	PU52047-3	Label	Dolby	5-B	1
23	PU33088-3	Presetter Plate		2-C	1
⚠ 24	PU33131	Rear Plate (B)		3-D	1
25	PU51663	RF Plate (B)		3-D	1
⚠ 26	PU33245-13	Rating Plate		1-C	1
27	PU52578	Label	Tuner Preset	1-C	1
28	PU52803-2	Spacer		4-B	3
29	PU21349-28	Control Label		4-A	1
30	PU51917-3	Plate		3-B	1

7.2.3 Chassis assembly



— Chassis assembly list —

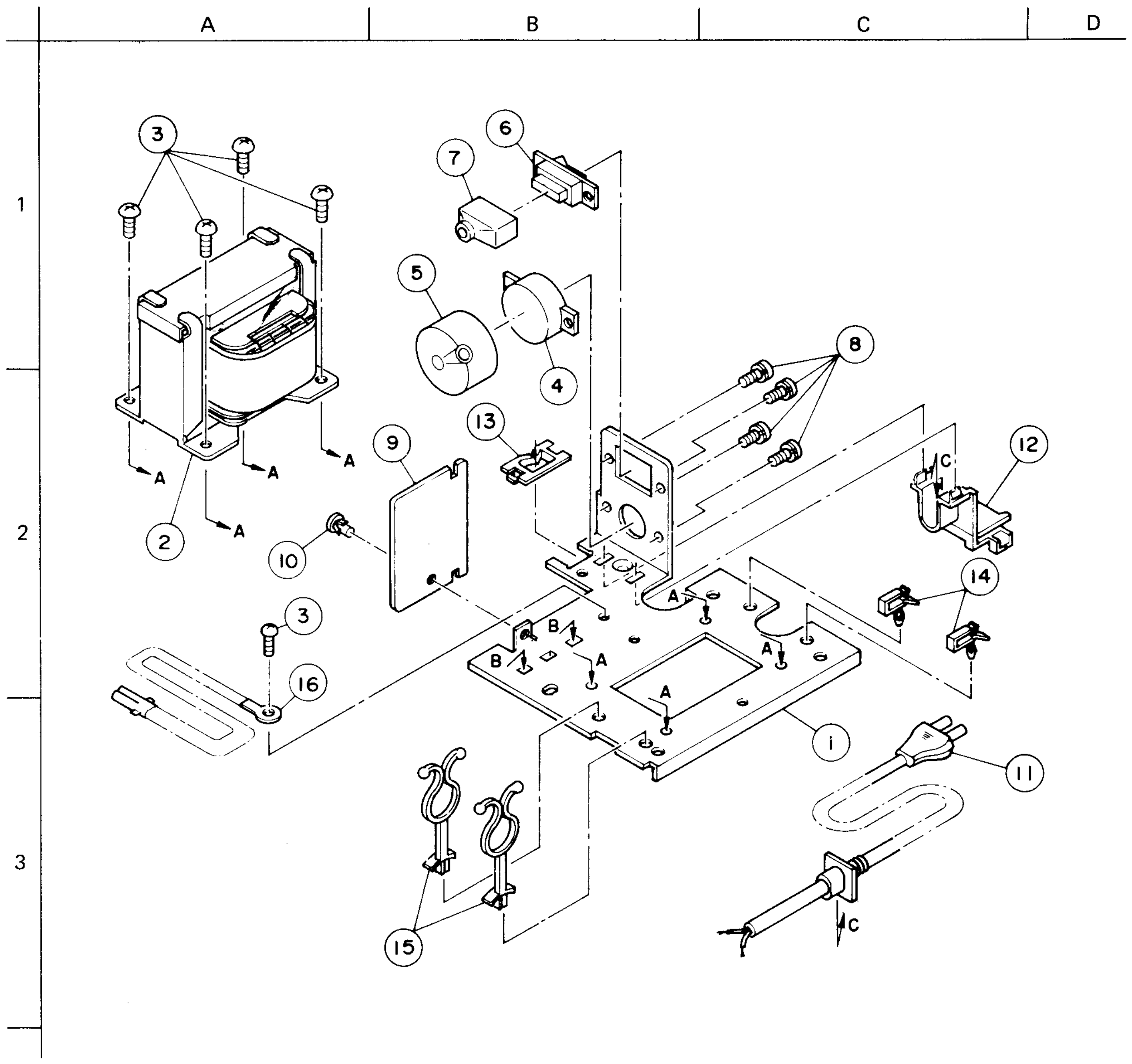
Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
⚠ 1	PU10376-1-6	Bottom Chassis		3-A	1
2	PU33277	Wire Holder		2-B	1
3	PU50627	Foot		3-B, 4-A, B	4
4	PU33078	Control Box (2)		4-B	1
5	PU49563-2	Camera Connector		4-B	1
6	SSSP3006Z	Screw		4-A	2
7	–	Switch Board	See Section 8.2.25	4-B	1
8	SDSA3008Z	Tapping Screw		5-A	2
⚠ 9	PU21205	Connector Panel		1-C	1
10	SDSA4012Z	Tapping Screw		1-C	2
11	PU51284	Sensor Holder		5-C	1
12	–	Start Sensor Board	(PT 01) See Section 8.2.1	5-C	1
13	PU48973	Stopper		4-D	1
14	SDSA3012Z	Tapping Screw		4-C	1
⚠ 15	PU32927M	RF Converter		4-C	1
16	PU33150	RF Converter Case		4-C	1
17	–	Tuner/IF Board Assembly	See Section 8.2.6	3-D	1
18	–	Tuner/Timer Control Board Assembly	See Section 8.2.7	3-D	1
19	–	Tuner/Timer Sub Board Assembly	See Section 8.2.29	5-D	1
20	–	Mix Booster Board Assembly	See Section 8.2.31	1-B	1
21	SDSP3008RS	Screw		1-C	3
22	–	Display Board Assembly	See Section 8.2.8	5-A	1
23	SDSA3008Z	Tapping Screw		5-A	4
24	–	Y & Pre/Rec Board Assembly	See Section 8.2.15	2-A	1
25	–	Color Board Assembly	See Section 8.2.9	2-A	1
26	PU51629-1-3	Connector Assembly		1-C	1
27	–	Terminal Board Assembly	See Section 8.2.26	1-C	1
28	SDSA3010R	Tapping Screw		1-C	2
29	–	Audio Board Assembly	See Section 8.2.17	2-B	1
30	–	Servo Board Assembly	See Section 8.2.14	5-A	1
31	–	Mechacon Board Assembly	See Section 8.2.12	5-C	1
32	E48729-001	Plastic Rivet		5-C	2
33	PU51946-10	Pin Assembly		4-B	3
34	–	Video Sub Board Assembly	See Section 8.2.32	3-A	1
35	SDSA3012Z	Tapping Screw		5-B, C	5
36	–	Operation Board Assembly	See Section 8.2.13	3-A	1
37	SDSA3008Z	Tapping Screw		4-A	4
38	–	Regulator Board Assembly	See Section 8.2.10	2-C	1
⚠ 39	QMF51A2-2R0	Fuse	T2.0 A 250 V (F2)	2-C	1
⚠ 40	〃 -2R5	〃	T2.5 A 〃 (F3)	2-C	1
⚠ 41	〃 -2R5	〃	T2.5 A 〃 (F4)	2-C	1
⚠ 42	〃 -1R25	〃	T1.25 A 〃 (F6)	2-C	1
⚠ 43	PU33241	Heat Sink		2-D	1
44	PU52406	Shaft Clamp		2-C	1
45	–	Power Transistor Board	See Section 8.2.18	2-D	1
46	SBST3008Z	Tapping Screw		1-C, 2-C	2
47	–	Servo Power Transistor Board	See Section 8.2.33	2-C	1
48	–	Power Transformer Assembly	See Section 7.2.4	3-D	1
49	SDSA4012C	Tapping Screw		2-D	4
50	–	Main Deck Assembly	See Section 7.2.5	2-A	1
51	SDSA4012C	Tapping Screw		1-B	3
52	PU51817	Special Screw		1-B	2
53	PU33465	Shield Cover		1-B	1
54	P688-06A2A2LLGC	Wire Assembly		1-A	2
55	SDSA3008Z	Tapping Screw		1-B	2
56	–	Cassette Housing Assembly	See Section 7.2.7	1-A	1
57	SDSA4012Z	Tapping Screw		1-A	4
58	WBS4000N	Screw Washer		1-B	1
59	SBST3008Z	Tapping Screw		5-B	2
60	PU33070-1-4	Pre-setter Cover		3-D	1
61	PU52429A	Shield Case Assembly		2-C	1
62	LPSP3006ZS	Screw		1-C	1
63	PU52567	Wire Clip		5-C	3
64	–	NTSC Color Board Assembly	See Section 8.2.11	3-C	1
65	–	Video Control Board Assembly	See Section 8.2.23	3-A	1
66	–	P.B. Chroma Amp. Board Assembly	See Section 8.2.24	2-B	1
⚠ 67	QMF51A2-1R25	Fuse	T1.25 A 250 V (F1)	3-C	1
⚠ 68	PU33151	AC Cover		3-C	1
69	PU54712	Shield Plate		3-A	1



– Chassis assembly list –

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
⚠ 1	PU10376-1-6	Bottom Chassis		3-A	1
2	PU33277	Wire Holder		2-B	1
3	PU50627	Foot		3-B, 4-A, B	4
4	PU33078	Control Box (2)		4-B	1
5	PU49563-2	Camera Connector		4-B	1
6	SSSP3006Z	Screw		4-A	2
7	–	Switch Board	See Section 8.2.25	4-B	1
8	SDSA3008Z	Tapping Screw		5-A	2
⚠ 9	PU21205	Connector Panel		1-C	1
10	SDSA4012Z	Tapping Screw		1-C	2
11	PU51284	Sensor Holder		5-C	1
12	–	Start Sensor Board	(PT 01) See Section 8.2.1	5-C	1
13	PU48973	Stopper		4-D	1
14	SDSA3012Z	Tapping Screw		4-C	1
⚠ 15	PU32927M	RF Converter		4-C	1
16	PU33150	RF Converter Case		4-C	1
17	–	Tuner/IF Board Assembly	See Section 8.2.6	3-D	1
18	–	Tuner/Timer Control Board Assembly	See Section 8.2.7	3-D	1
19	–	Tuner/Timer Sub Board Assembly	See Section 8.2.29	5-D	1
20	–	Mix Booster Board Assembly	See Section 8.2.31	1-B	1
21	SDSP3008RS	Screw		1-C	3
22	–	Display Board Assembly	See Section 8.2.8	5-A	1
23	SDSA3008Z	Tapping Screw		5-A	4
24	–	Y & Pre/Rec Board Assembly	See Section 8.2.15	2-A	1
25	–	Color Board Assembly	See Section 8.2.9	2-A	1
26	PU51629-1-3	Connector Assembly		1-C	1
27	–	Terminal Board Assembly	See Section 8.2.26	1-C	1
28	SDSA3010R	Tapping Screw		1-C	2
29	–	Audio Board Assembly	See Section 8.2.17	2-B	1
30	–	Servo Board Assembly	See Section 8.2.14	5-A	1
31	–	Mechacon Board Assembly	See Section 8.2.12	5-C	1
32	E48729-001	Plastic Rivet		5-C	2
33	PU51946-10	Pin Assembly		4-B	3
34	–	Video Sub Board Assembly	See Section 8.2.32	3-A	1
35	SDSA3012Z	Tapping Screw		5-B, C	5
36	–	Operation Board Assembly	See Section 8.2.13	3-A	1
37	SDSA3008Z	Tapping Screw		4-A	4
38	–	Regulator Board Assembly	See Section 8.2.10	2-C	1
⚠ 39	QMF51A2-2R0	Fuse	T2.0 A 250 V (F2)	2-C	1
⚠ 40	″ -2R5	″	T2.5 A ″ (F3)	2-C	1
⚠ 41	″ -2R5	″	T2.5 A ″ (F4)	2-C	1
⚠ 42	″ -1R25	″	T1.25 A ″ (F6)	2-C	1
⚠ 43	PU33241	Heat Sink		2-D	1
44	PU52406	Shaft Clamp		2-C	1
45	–	Power Transistor Board	See Section 8.2.18	2-D	1
46	SBST3008Z	Tapping Screw		1-C, 2-C	2
47	–	Servo Power Transistor Board	See Section 8.2.33	2-C	1
48	–	Power Transformer Assembly	See Section 7.2.4	3-D	1
49	SDSA4012C	Tapping Screw		2-D	4
50	–	Main Deck Assembly	See Section 7.2.5	2-A	1
51	SDSA4012C	Tapping Screw		1-B	3
52	PU51817	Special Screw		1-B	2
53	PU33465	Shield Cover		1-B	1
54	P688-06A2A2LLGC	Wire Assembly		1-A	2
55	SDSA3008Z	Tapping Screw		1-B	2
56	–	Cassette Housing Assembly	See Section 7.2.7	1-A	1
57	SDSA4012Z	Tapping Screw		1-A	4
58	WBS4000N	Screw Washer		1-B	1
59	SBST3008Z	Tapping Screw		5-B	2
60	PU33070-1-4	Pre-setter Cover		3-D	1
61	PU52429A	Shield Case Assembly		2-C	1
62	LPSP3006ZS	Screw		1-C	1
63	PU52567	Wire Clip		5-C	3
64	–	NTSC Color Board Assembly	See Section 8.2.11	3-C	1
65	–	Video Control Board Assembly	See Section 8.2.23	3-A	1
66	–	P.B. Chroma Amp. Board Assembly	See Section 8.2.24	2-B	1
⚠ 67	QMF51A2-1R25	Fuse	T1.25 A 250 V (F1)	3-C	1
⚠ 68	PU33151	AC Cover		3-C	1
69	PU54712	Shield Plate		3-A	1

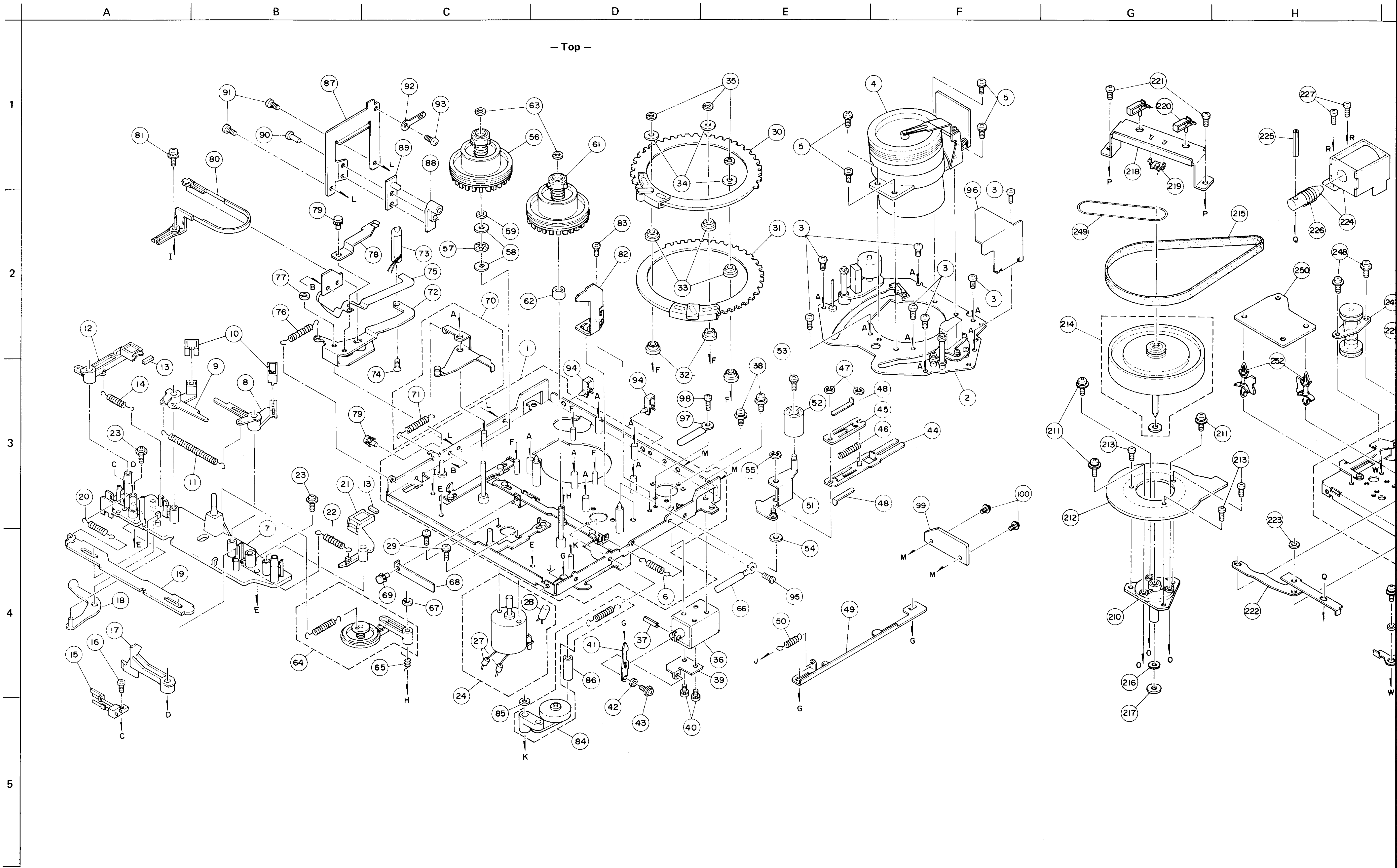
7.2.4 Power transformer assembly



– Power transformer assembly list –

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
⚠ 1	PU33240	Power Trans. Bracket		3-C	1
⚠ 2	PU51920	Power Transformer		2-A	1
3	SBSB4006Z	Tapping Screw		1-A, 2-A	5
⚠ 4	QSR0085-002	Voltage Selector		2-B	1
⚠ 5	PU50317	Voltage Selector Cover		1-B	1
⚠ 6	QSE1135-007	Power Switch		1-B	1
⚠ 7	PU50479	Power Switch Cover		1-B	1
⚠ 8	LPSP3006ZS	Screw		1-C	4
9	–	Fuse Board	See Section 8.2.16	2-B	1
⚠10	E48729-001	Plastic Rivet		2-A	1
⚠11	QMP3960-200B	Power Cord		3-D	1
⚠12	PU51538	Cord Clamp		2-D	1
⚠13	PU48086	Edge Saddle		2-B	1
⚠14	PU48016	Mini Clamp		2-C	2
⚠15	PU52167	Lead Clamp		3-B	2
16	P688-40A2A2LLGS	Wire Assembly		2-A	1
⚠–	PU52092A	Power Transformer Assembly	Incl. (1) – (16)	–	–

7.2.5 Main deck assembly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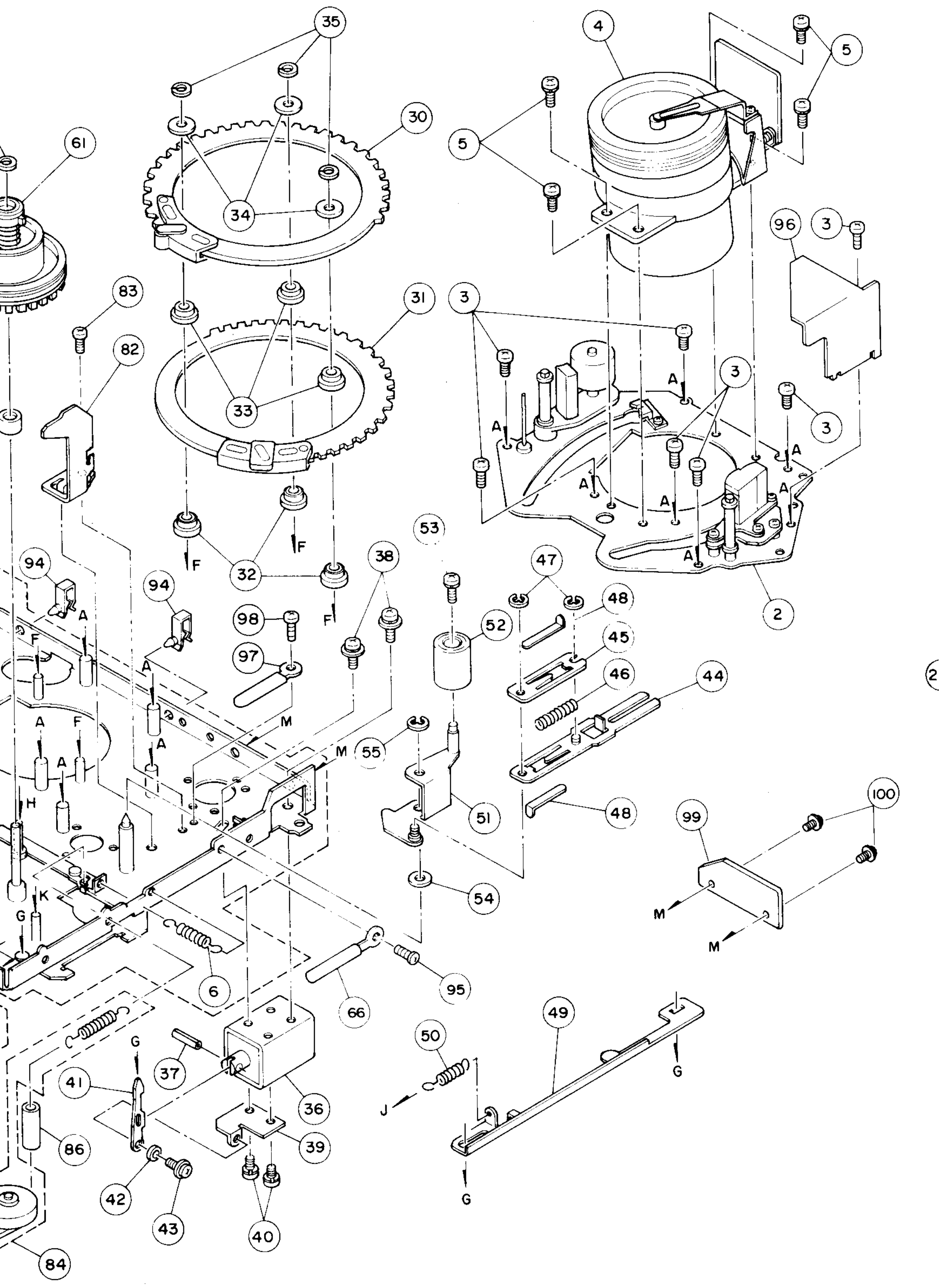

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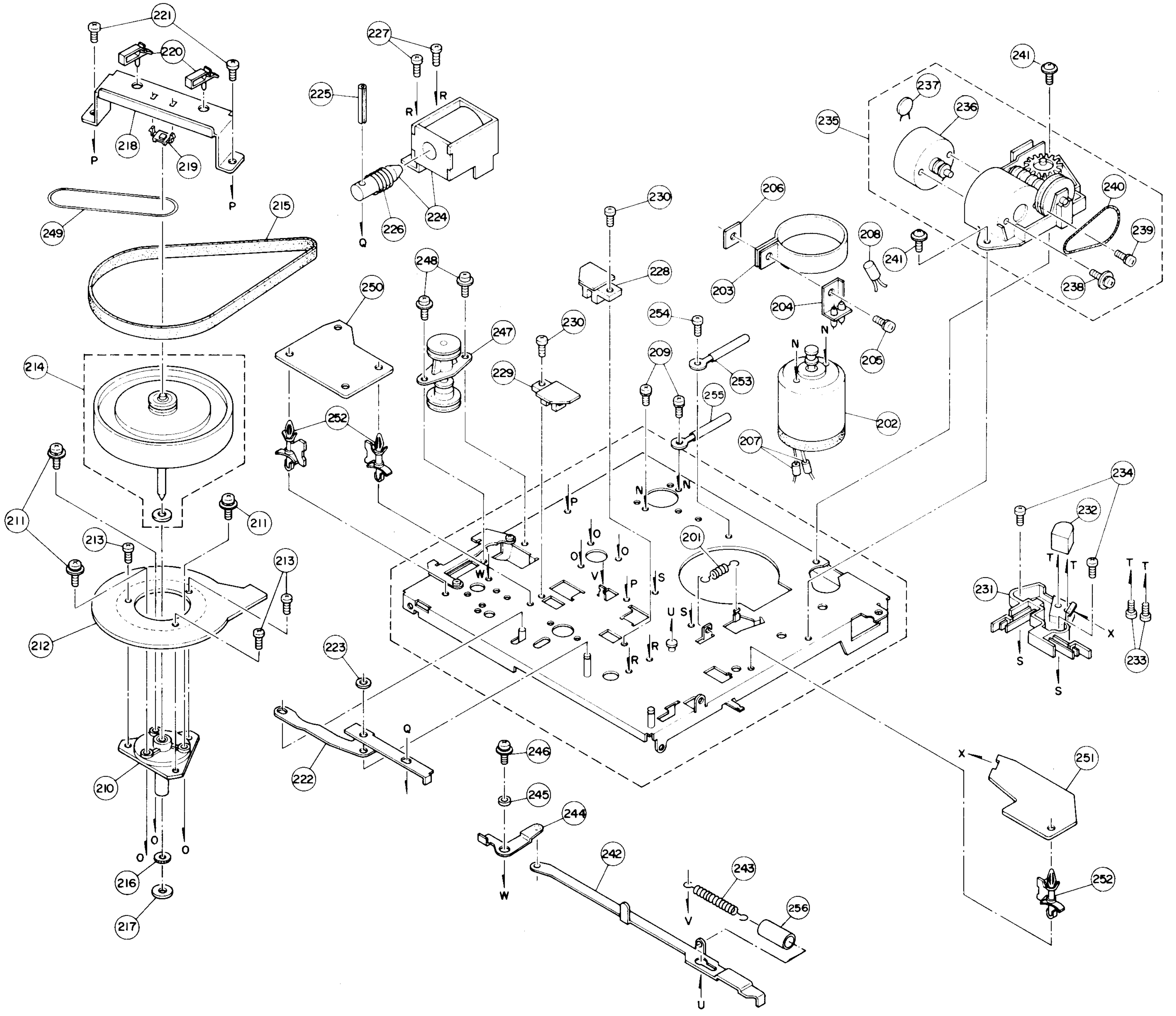

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– Main deck assembly list (Top) –

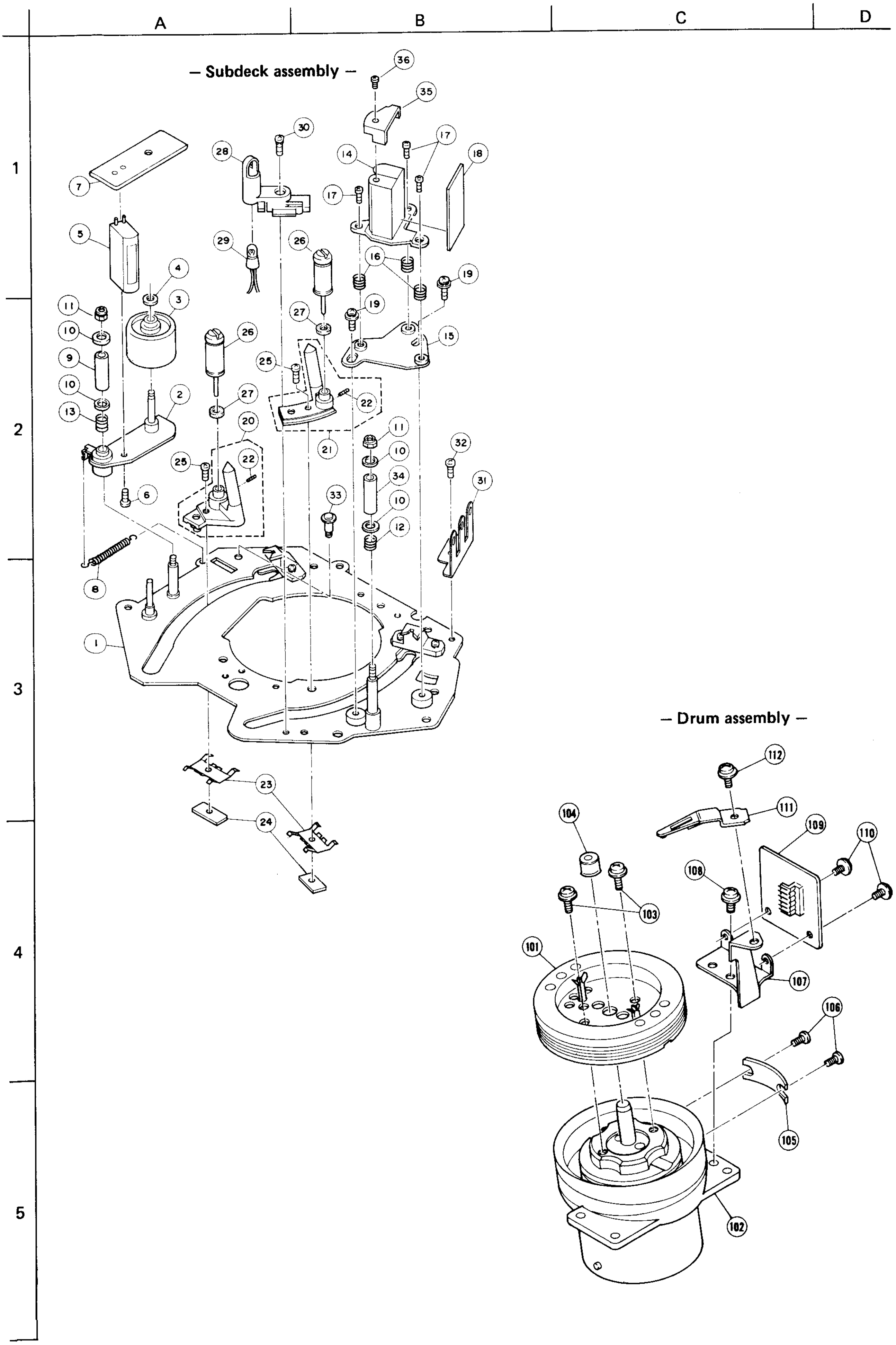
Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
1	PU21178D-13	Main Deck Assembly		2-C	1
2	–	Sub Deck Assembly	See Section 7.2.6	3-F	1
3	SDSP3008ZS	Screw		2-E, F	7
4	–	Drum Assembly	See Section 7.2.6	1-F	1
5	LPSP3010ZS	Screw		1-E, F	4
6	PUM30001-45	Spring		4-D	1
7	PU21195	Mould Base		4-B	1
8	PU50671	Take-up Main Brake		3-B	1
9	PU50713	Supply Main Brake		3-B	1
10	PU50670	Brake Shoe		2-B	2
11	PUM30001-38	Spring		3-B	1
12	PU51384	Loading Tension Brake		2-A	1
13	PUM30019-2	Pad	Overhaul Part	3-A, C	2
14	PUM30001-39	Spring		3-A	1
15	PU51259	Leaf Switch	S003	4-A	1
16	SBSF2006Z	Tapping Screw		4-A	1
17	PU50579	Record Safety Arm		4-A	1
18	PU51522	Change Lever		4-A	1
19	PU51523	Connect Plate		4-A	1
20	PUM30001-55	Spring		3-A	1
21	PU51524	Take-up Back Tension Brake		3-B	1
22	PUM30001-39	Spring		3-B	1
23	DPSP3008ZS	Screw		3-A, B	2
⚠ 24	PU53577V	Reel Motor Assembly	M003 Overhaul Part C005, 007	4-C	1
25	–	–		–	–
26	–	–		–	–
27	PU45811	Ferrite Bead		4-C	2
28	QEN41HM-105	Electrolytic Capacitor	C006 (1 μF, 50 V)	4-D	1
29	LPSP3005ZS	Screw		4-C	2
30	PU48837B	Supply Loading Ring Assembly		1-E	1
31	PU48838C	Take-up Loading Ring Assembly		2-E	1
32	PU51356	Collar		3-D	3
33	PU51357	"		2-D	3
34	PUM30018-2	Spacer		1-D	3
35	PUM30017-4	Slit Washer		1-E	3
⚠ 36	PU51900-1-2	Pinch Roller Solenoid	PG02	4-E	1
37	PRE3008	Spring Pin		4-D	1
38	DPSP3006ZS	Screw		3-E	2
39	PU49521	Bracket		4-E	1
40	LPSP3004ZS	Screw		5-D	2
41	PU52430	Connect Plate		4-D	1
42	T30302-9	Collar		5-D	1
43	DPSP3006ZS	Screw		5-D	1
44	PU51359A	Spring Holder Assembly		3-F	1
45	PU51361	Spring Holder		3-F	1
46	PUM30002-29	Spring		3-F	1
47	REE2500	E-Ring		3-E	2
48	PU51385-1-1	Spacer		3-F	2
49	PU51861	Connect Plate		4-E	1
50	PUM30001-59	Spring		4-E	1
51	PU51862A	Pinch Roller Arm Assembly		3-E	1
52	PU51367A	Pinch Roller Assembly	Overhaul Part	3-E	1
53	LPSP2604Z	Screw		2-E	1
54	PUM30018-3	Spacer		4-E	1
55	REE5000	E-Ring		3-E	1

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
56	PU48907D	Supply Reel Disk Assembly	Overhaul Part	1-D	1
57	PU32921A	Thrust Bearing Assembly		2-C	1
58	PUM30018-6	Spacer		2-C	2
59	Q03093-828	Washer		2-C	1
60	–	–		–	–
61	PU48907E	Take-up Reel Disk Assembly	Overhaul Part	1-D	1
62	PU51550	Collar		2-D	1
63	PUM30017-5	Slit Washer		1-D	2
64	PU48967B	Reel Idler Assembly	Overhaul Part	4-B	1
65	PU51794	Spring		4-C	1
66	PU49485	Wire Clamp		4-E	1
67	PUM30017-8	Slit Washer		4-C	1
68	PU49588	Plate Spring		4-C	1
69	E48729-009	Plastic Rivet		4-C	1
70	PU51388B-4	Cancel Lever Assembly		2-C	1
71	PUM30001-32	Spring		3-C	1
72	PU52267	Tension Arm		2-C	1
73	PU49654	Cue Head	H008 Overhaul Part	2-C	1
74	SSSP2605Z	Screw		3-C	1
75	–	Cue Head Board	See Section 8.2.21	2-C	1
76	PUM30001-62	Spring		2-B	1
77	PUM30017-5	Slit Washer		2-B	1
78	PU52269	Stopper		2-C	1
79	E48729-009	Plastic Rivet		2-B, 3-C	2
80	PU51390A	Tension Band Assembly	Overhaul Part	1-B	1
81	DPSP3008ZS	Screw		1-A	1
82	PU51606	Cassette Door Guide		2-D	1
83	LPSP3005ZS	Screw		2-D	1
84	PU51402	Take-up Idler Assembly	Overhaul Part	5-D	1
85	PUM30017-8	Slit Washer		5-C	1
86	QXT341H-010	UL Tube		4-D	1
87	PU51468	End Sensor Bracket		1-B	1
88	PU51285	Sensor Holder		1-C	1
89	–	End Sensor Board	(PT 02) See Section 8.2.2	1-C	1
90	PU48973-3	Stopper		1-B	1
91	LPSP3006ZS	Screw		1-B	2
92	PU51692	Earth Lug		1-C	1
93	SBST3006ZS	Tapping Screw		1-C	1
94	PU48016	Mini Clamp		3-D	2
95	SBST3005ZS	Tapping Screw		4-E	1
96	PU52499	Shield Plate		1-F	1
97	PU49485-3	Wire Clamp		3-D	1
98	SBST3006ZS	Tapping Screw		3-D	1
99	PU53117	PWB Holder Plate		4-F	1
100	GBST3006Z	Tapping Screw		4-F	2

– **Main deck assembly list (Bottom)** –

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
201	PUM30001-104	Spring		3-I	1
⚠202	PU53994P	Capstan Motor Assembly	M002 Overhaul Part	3-J	1
203	PU45980	Capstan Motor Band		2-I	1
204	PU51324	Feed Through Capacitor	C002, 004	2-J	1
205	LPSP3008ZS	Screw		2-J	1
206	PU43730	Tapping Plate		2-J	1
207	PU45811	Ferrite Bead		3-J	2
208	QEN41HM-105	Electrolytic Capacitor	C003 (1 μF, 50 V)	2-J	1
209	LPSP3005ZS	Screw		2-I	2
210	PU33273A	Capstan Housing Sub Assembly		4-G	1
211	DPSP3014ZS	Screw		3-G, H	3
212	–	Capstan F.G Board	See Section 8.2.22	3-G	1
213	SDST2606Z	Tapping Screw		3-G, H	3
214	PU33265D	Capstan Flywheel Assembly		2-G	1
215	PU49164	Capstan Belt	Overhaul Part	2-H	1
216	PUM30018-1	Spacer		4-G	1
217	PU52183	Capstan Oil Seal		5-G	1
218	PU51313	Bracket		1-G	1
219	PU47212	Thrust Bearing		1-G	1
220	PU48016-2	Mini Clamp		1-G	2
221	SBST3006ZS	Tapping Screw		1-G	2
222	PU51341	Brake Arm		4-H	1
223	PUM30017-8	Slit Washer		3-H	1
⚠224	PU51873-1-2	Brake Solenoid	PG01	2-H	1
225	PRE3016	Spring Pin		1-H	1
226	PUM30002-21	Spring		2-H	1
227	SBST3006ZS	Tapping Screw		1-H	2
228	–	Supply Reel FG Board	(PI 01) See Section 8.2.19	2-I	1
229	–	Take-up Reel FG Board	(PI 02) See Section 8.2.20	2-I	1
230	SBST3008ZS	Tapping Screw		2-I	2
231	PU53995	Leaf Switch	S001, 002	3-K	1
232	PU51815	Pick-up Head	H007	3-K	1
233	SPSP2004Z	Screw		3-K	2
234	LPSP3008ZS	Screw		3-K	2
235	PU51859A-2	Loarding Gear Assembly		1-J	1
⚠236	PU52503A	Loarding Motor Assembly	M004 Overhaul Part	1-J	1
237	QCF71HP-473	Ceramic Capacitor	C001 (0.047 μF, 50 V)	1-J	1
238	DPSP2605Z	Screw		2-K	1
239	SDSP2605Z	"		2-K	1
240	PU50350	Loarding Belt	Overhaul Part	2-K	1
241	GBST3008ZS	Tapping Screw		1-K, 2-J	2
242	PU51369	Back Tension Cancel Plate		4-I	1
243	PUM30001-54	Spring		4-J	1
244	PU51370A	Connect Lever Assembly		4-I	1
245	PU43769-15	Collar		4-I	1
246	DPSP3006ZS	Screw		4-I	1
247	PU53462A	Take-up Clutch Assembly	Overhaul Part	2-I	1
248	SPSP3006ZS	Screw		2-H	2
249	PUM30003-1	Take-up Clutch Belt	Overhaul Part	2-G	1
250	–	Junction Board	See Section 8.2.28	2-H	1
251	–	Relay Board	See Section 8.2.30	4-K	1
252	PU52784	Locking Circuit Board Supporter		3-H, 4-K	3
253	PU49485	Wire Clamp		2-J	1
254	SBST3006ZS	Tapping Screw		2-I	1
255	PU49485-3	Wire Clamp		2-I	1
256	QXT652H-020	Tube		5-J	1

7.2.6 Subdeck and drum assemblies



– Subdeck assembly –

– Drum assembly –

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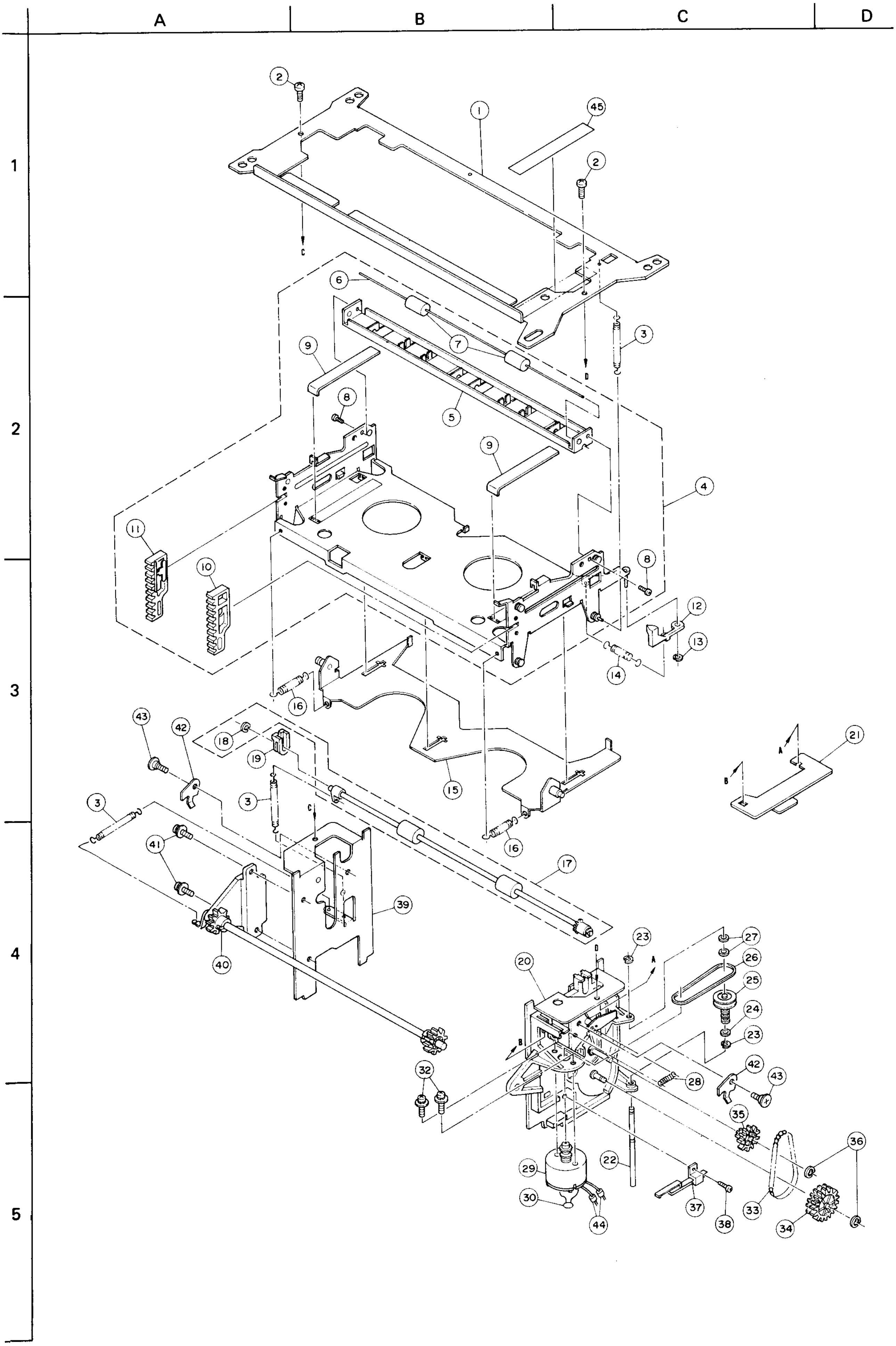
— Sub deck assembly list —

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
1	PUS46182B	Sub Deck Sub Assembly		3-A	1
2	PU52847A	Erase Head Arm Sub Assembly		2-A	1
3	PU51292A	Impedance Roller Assembly		2-A	1
4	PUM30017-1	Slit Washer		1-A	1
5	PU51263-2	Full Erase Head	H001 Overhaul Part	1-A	1
6	LPSP2004Z	Screw		2-A	1
7	—	Full Erase Head Board	See Section 8.2.3	1-A	1
8	T30300-004	Spring		3-A	1
9	PU53826	Guide Pole		2-A	1
10	PU51294	Guide Flange		2-A, B	4
11	PU49276	Nut		2-A, B	2
12	PU30080-49	Spring		2-B	1
13	″ -69	″		2-A	1
14	PU51903C	Audio/Control Head Assembly	H002, 003, 004 Overhaul Part	1-B	1
15	PU51296A	Base Assembly		2-B	1
16	PU30080-49	Spring		1-B	3
17	SPSP2608ZY	Screw		1-B	3
18	—	Audio/Control Head Board	See Section 8.2.4	1-B	1
19	DPSP3006ZS	Screw		1-B, 2-B	2
20	PU48740B	Supply Pole Base Assembly		2-A	1
21	PU48745B	Take-up Pole Base Assembly		2-B	1
22	YFS3002.5FS	Set Screw		2-A, B	2
23	PU51299	Spring Plate		3-A	2
24	PU51638	Plate		4-A	2
25	SPSP2606Z	Screw		2-A	2
26	PU48748B	Guide Roller Assembly		1-B, 2-A	2
27	PU48806-3	Rubber Tire		2-A, B	2
28	PU48737	Lamp Holder		1-A	1
29	PU49557-3-3	Cassette Lamp	PL01	1-A	1
30	LPSP3006ZS	Screw		1-B	1
31	PU51842	Earth Lug		2-B	1
32	LPSP3006ZS	Tapping Screw		2-B	1
33	PU54648	Flange Screw		2-B	1
34	PU53826-2	Guide Pole		2-B	1
35	PU54178	Shield Cap		1-B	1
36	HPSP2020N	Screw		1-B	1

— Drum assembly list —

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
101	PU31332L	Upper Drum Assembly	(H005, 006) Overhaul Part	4-B	1
⚠102	PUS36293F	Lower Drum Assembly	(M001)	5-C	1
103	NDBP3010NS	Screw		4-C	2
104	PU49483	Commutator	Overhaul Part	4-C	1
105	PU48700	Heater Assembly	R001	5-C	1
106	SDBP3004NS	Screw		4-D	2
107	PU52147	Bracket		4-C	1
108	DPSP3006ZS	Screw		4-C	1
109	—	Video Head Board	See Section 8.2.5	4-C	1
110	DPSP3006ZS	Screw		4-D	2
111	PU48678A	Brush Assembly	Overhaul Part	3-C	1
112	DPSP3006ZS	Screw		3-C	1

7.2.7 Cassette housing assembly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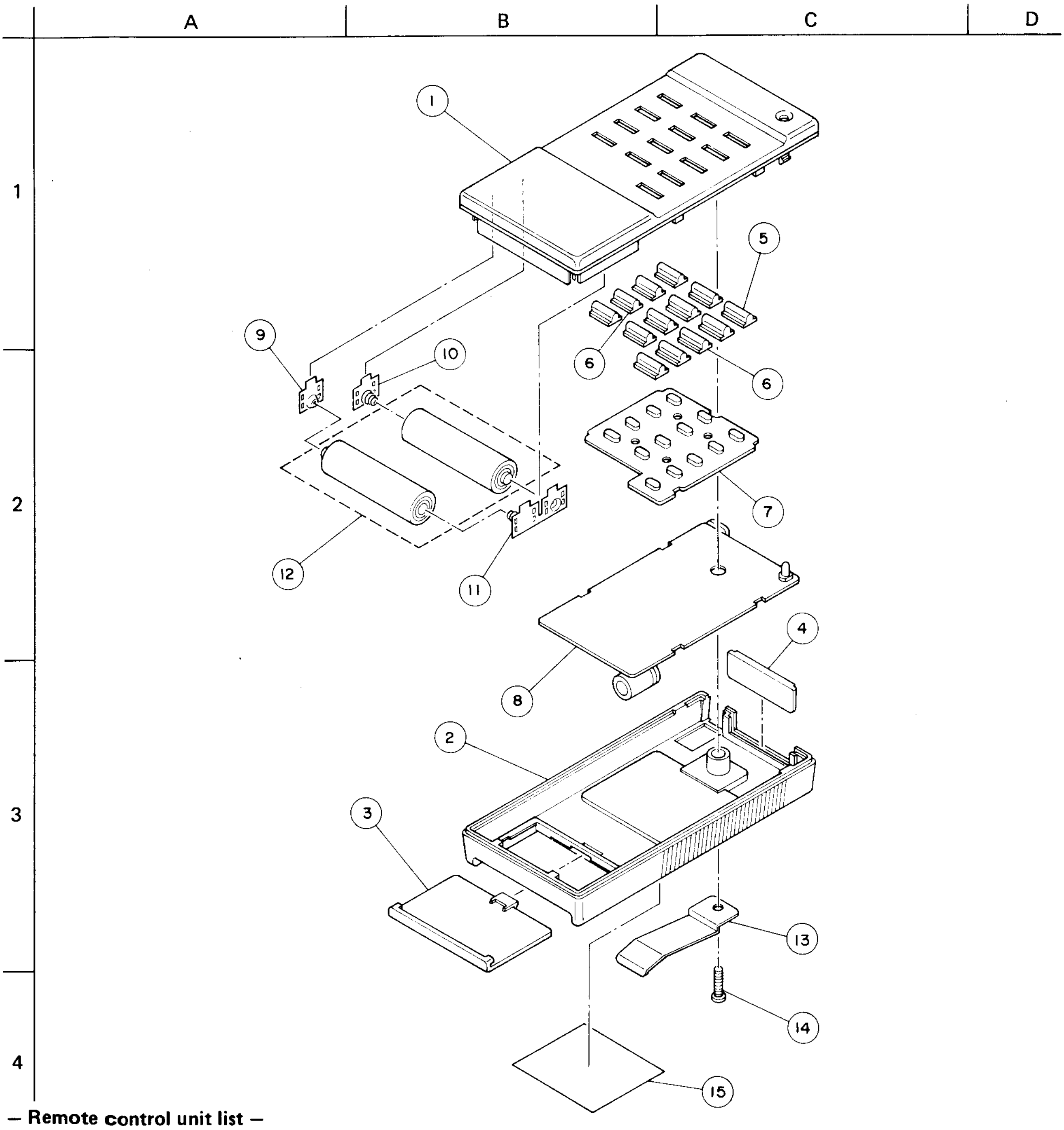
– Cassette housing assembly list –

Symbol No.	Part No.	Part Name	Description	Symbol No. Position	Q'ty
1	PU33100-1-2	Roof Frame		1-B	1
2	SBST3006ZS	Tapping Screw		1-A, C	2
3	PUM30001-63	Spring		2-C, 3-A	3
4	PU21221A-2	Cassette Housing Sub Assembly		2-C	1
5	PU33237	Reinforcement		2-B	1
6	PU51870	Rod		1-B	1
7	PU51947	Roller		2-B	2
8	LPSP2006Z	Screw		2-B, 3-C	2
9	PU49001B	Tephron Sheet Assembly		2-B	2
10	PU51614-1-2	Rack Gear (R)		3-A	1
11	PU51614-2-2	" (L)		2-A	1
12	PU49656-1-2	Lid Opener		3-C	1
13	REE2000	E-Ring		3-C	1
14	PU35005-79	Spring		3-C	1
15	PU33096A	Slide Plate Assembly		3-B	1
16	PU35005-17	Spring		3-B, 4-B	2
17	PU49042A	Roller Assembly	Overhaul Part	4-C	1
18	REE3000	E-Ring		3-A	1
19	PU49046	Roller Bearing		3-A	1
20	PU33348B	Guide Stay (R) Assembly		4-B	1
21	–	Cassette Photo Interrupter Board	(PI 03) See Section 8.2.27	3-D	1
22	PU49000	Shaft		5-C	1
23	REE2000	E-Ring		4-C	2
24	Q03093-834	Washer		4-C	1
25	PU49026	Worm Gear		4-C	1
26	PU48941	Belt	Overhaul Part	4-C	1
27	Q03093-834	Washer		4-C	2
28	PU35005-104	Spring		4-C	1
⚠ 29	PU49158B	Cassette Motor Assembly	M005 Overhaul Part	5-B	1
30	QCF11HP-473	Ceramic Capacitor	C008 (0.047 μF, 50 V)	5-B	1
31	–	–		–	–
32	LPSP2605Z	Screw		4-B	2
33	PU49031-3	Ladder Chain		5-C	1
34	PU32937	Sprocket Gear		5-C	1
35	PU49032	Worm Wheel Gear		5-C	1
36	REE2500	E-Ring		5-D	2
37	PU51259-2	Cassette Switch	S004	5-C	1
38	SPSP2004Z	Screw		5-C	1
39	PU51616	Guide Stay (L)		4-B	1
40	PU32453A	Connect Gear Assembly	Incl. (41)	4-A	1
41	DPSP3006Z	Screw		4-A	2
42	PU49030	Assist. Plate		3-A, 4-C	2
43	PU50039	Fulcrum Screw		3-A, 4-C	2
44	PU45811	Ferrite Bead		5-C	2
45	PU52763	Insulator		1-C	1
–	PUS26216C	Cassette Housing Assembly	Incl. (1) – (30), (32) – (45)	–	–

7.2.8 Remote control unit



– Remote control unit list –

Symbol No.	Part No.	Part Name	Discription	Symbol No. Position	Q'ty
1	UR52VCS4	Upper Case Assembly		1-B	1
2	UR52CS23	Lower Case		3-B	1
3	UR52EC24	Battery Cover		3-B	1
4	UR52SB26	I.F.R Window Glass		2-C	1
5	UR52BT25	Button	Dark Gray	1-C	11
6	UR52BT25A	"	Red	2-B, C	2
7	UR52CT28	Key-top Rubber		2-C	1
8	–	Remote Control Board Assembly	See Section 8.2.34	3-B	1
9	URC270TD10	Contact Piece		1-A	1
10	URC270VTD3	"		2-B	1
11	URC270VTD4	"		2-B	1
12	–	Battery	See Section 7.2.1	2-A	2
13	–	Hook	See Section 7.2.1	3-C	1
14	XSB26+14FC	Screw		4-C	1
15	UR52LB30A	Lavel		4-C	1
⚠ –	PU52097C	Remote Control Unit	Incl. (1) – (11), (14) – (15)	–	–

SECTION 8
ELECTRICAL PARTS LIST

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SAFETY PRECAUTION

Parts identified by the ⚠ symbol are critical for safety. Replace only with specified part numbers.

ABBREVIATIONS IN THIS LIST ARE AS FOLLOWS:

RESISTORS – All resistance values are in ohms (Ω).

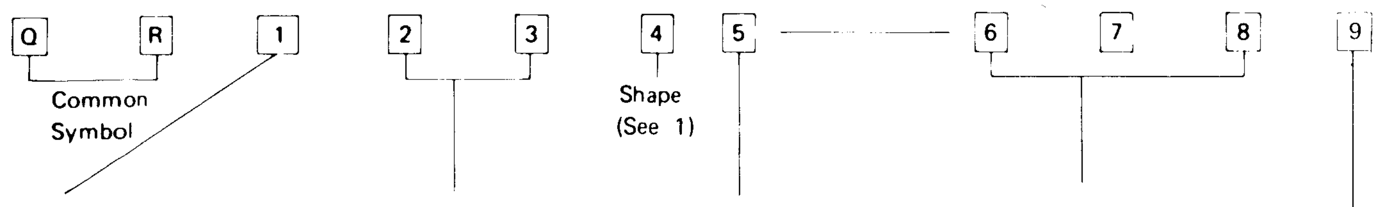
K	1 000
M	1 000 000
CR	Carbon Resistor
Comp. R	Composition Resistor
WR	Wire Wound Resistor
OMR	Oxide Metal Film Resistor
VR	Variable Resistor (Potentiometer)
MFR	Metal Film Resistor
FR	Fusible Resistor

CAPACITORS – All capacitance values are in μF, unless otherwise indicated.

P	μμF
C Cap	Ceramic Capacitor
E Cap	Electrolytic Capacitor (L. L : Low Leakage)
FM Cap	Film Mica Capacitor
MM Cap	Metalized Mylar Capacitor
MP Cap	Metalized Paper Capacitor
MY Cap	Mylar Capacitor
NP Cap	Non-polar Capacitor
PC Cap	Polycarbonate Capacitor
PP Cap	Poly Pro Capacitor
PS Cap	Polystyrol Capacitor
T Cap	Tantalum Capacitor
TR Cap	Trimmer Capacitor

8.1 STANDARD PART NUMBER CODING

8.1.1 Fixed Resistor Coding



Type of resistor

C	Composition Resistor
D	Carbon Resistor
F	Unflammable Resistor
G	Oxide Metal Film Resistor
M	Metal Plate Resistor
X	Metal Film Resistor
W	Wire Wound Resistor
Y	Wire Wound Resistor
V	Metal Film Resistor, High Stability
Z	Special Resistor

Rated Wattage

Symbol	Rated wattage
16	1/6 (W)
18	1/8 "
14	1/4 "
12	1/2 "
01	1 "
02	2 "
03	3 "
04	4 "
05	5 "
06	6 "
07	7 "
75	7.5 "
08	8 "
10	10 "
15	15 "
20	20 "
30	30 "

Tolerance

Symbol	Tolerance
F	±1 %
G	±2 %
J	±5 %
K	±10 %
M	±20 %

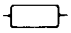
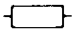
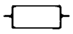
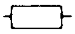
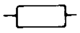
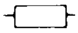
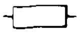
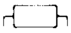
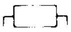
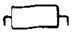
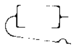
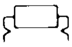
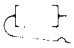
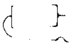
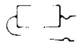
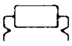
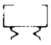
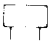
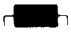
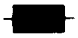
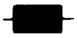
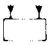
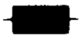
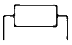
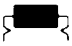
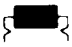
Values

– Example –		
R47		0.47 Ω
4R7		4.7 Ω
470	47 x 10^0	47 Ω
471	47 x 10^1	470 Ω
472	47 x 10^2	4.7 KΩ
473	47 x 10^3	47 KΩ
474	47 x 10^4	470 KΩ
475	47 x 10^5	4.7 MΩ
10R2		10.2 Ω
1430	143 x 10^0	143 Ω
1581	158 x 10^1	1.58 KΩ

Size

Symbol	Size
A	Small Size
S	Small Size

1) Shape of resistor (■ : Flame retardant resistor)

Sort	C	D	G	F	M	W	X	Y	V
1									
2									
3									
4									
5						L type			
6						Resin Covered			
7						Enameled			
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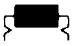
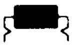
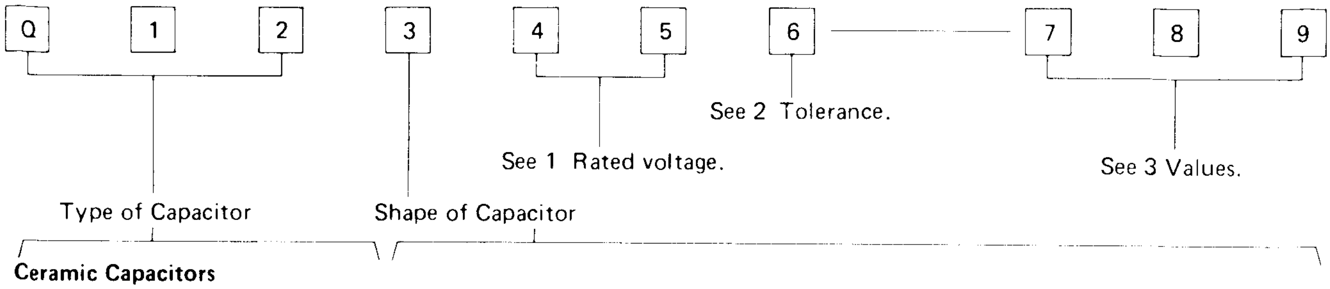
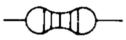
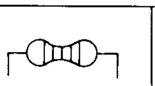
9									

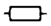
8.1.2 Fixed Capacitor Coding


Q
1
2
3
4
5
6
7
8
9
See 2 Tolerance.
See 1 Rated voltage.
See 3 Values.
Type of Capacitor
Shape of Capacitor

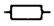
Ceramic Capacitors

Symbol	Type of Capacitor	Disk Lead	Kink Lead			
QCC	Ceramic			4	5	
QCF	″	1	3			
QCS	″	1	3			
QCX	″			1	3	
QCY	″	1,4	3			
QCT	Temperature compensation					
QCZ	Special					

Electrolytic Capacitors

Symbol	Type of Capacitor	Tubular 	Mono-direction	Anti-stress	Forming	Snap-in
QEA	Characteristic A	2	4			
QEB	Low leakage		4	5	6	
QED	Characteristic D	2	4			
QEE	Tantalum		4	5		
QEE	″ (small type)		8			
QEL	Characteristic L					7
QEN	Non-polar	2	4	5	6	
QEW	Characterisitc W	2	4	5	6	7
QET	Characteristic W (small type)	2	4	5	6	
QEK	Characteristic W (subminiature type)		4	5		
QEZ	Special					

Paper Film Capacitors

Symbol	Type of Capacitor	Tubular 	Normal		Flame retardant	
			Mono-direction	Kink Lead	Mono-direction	Kink Lead
QFF	Film mica		4			
QFH	Metalized mylar	2	4	3	5	6
QFM	Mylar	2	4	3, 7	5	6
QFN	″ (small type)		4			
QFP	Polypropylene		4	3		
QFS	Polystyrole	2	4	3		
QFZ	Special					

1) Rated voltage (V)

2nd letter First letter	A	B	C	D	E	F	G	H	J	K	V	W	X
0						3.15			6.3				
1	10		16	20	25		40	50	63		35		
2	100	125	160	200	250	315	400	500	630		350	450	600
3	1000	1250		2000				5000					

2) Tolerance

Symbol	F	G	J	K	M	N	Z	P	A	H	R
(%)	±1	±2	±5	±10	±20	±30	+80 −20	+100 − 0	+100 − 10	+50 −10	+30 −10

3) Values

– Example – Values are in picofarads.

101 ..... 10×10^1..... 100 pF

102 ..... 10×10^2..... 1,000 pF

103 ..... 10×10^3..... 10,000 pF = 0.01 μF

104 ..... 10×10^4..... 100,000 pF = 0.1 μF

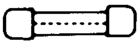
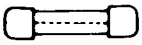
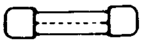
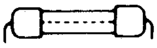
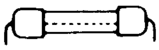
5R0 ..... 5.0 ..... 5 pF

8.1.3 Fuse Coding

Q M F 1 2 3 4 —— 5 6 7

COMMON SYMBOL

Shape of Fuse

Symbol No.	Shape	Remarks
51		ϕ 5.2 x 20
60		ϕ 6.4 x 30
61		ϕ 6.35 x 31.8
63		With 60 Lead Wire
66		With 61 Lead Wire

Rated Voltage

Symbol No.	Rated Voltage
1	AC 125 V
2	AC 250 V

Values

R10	0.1 A
R125	0.125 A
1R0	1.0 A
1R2	1.2 A
1R25	1.25 A
100	10 A

Characteristics

Symbol No.	Fusing current	Fusing time	Remarks
S	160%	Within 1 hr.	Anti-rush Type
	200%	" 2 min.	
	700%–2000%	" 0.01 sec.	
R	160%	" 1 hr.	Regular Fusible Type
	200%	" 2 min.	
M	135%	" 1 hr.	Regular Fusible Type (for UL)
	200%	" 2 min.	
U	135%	" 1 hr.	Anti-rush Type (for UL)
	200%	" 2 min.	
	800%–2000%	" 0.01 sec.	
A	210%	" 2 min.	Anti-rush Type (for Europe)
	275%	0.5 – 10 sec.	
	400%	0.15–2 sec.	
	1000%	0.02–0.3 sec.	
B	210%	Within 30 min.	Regular Fusible Type (for SEMKO, Europe)
	275%	0.05–2 sec.	
	400%	0.01–0.3 sec.	

8.2 ELECTRICAL PARTS LIST BY ASSEMBLIES

8.2.1 Start Sensor Board [0][1]

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51579	Circuit Board	
PT01	PN202S	Photo Transistor	

8.2.2 End Sensor Board [0][2]

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU49136	Circuit Board	
PT02	PN202S	Photo Transistor	

8.2.3 Full Erase Head Board [0][3]

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51720	Circuit Board	
	PU43351-102	Cap. Housing	1–2

8.2.4 Audio/Control Head Board [0][4]

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51904	Circuit Board	
R 1	QRD181J-100	CR	10
	PU43351-2	Cap. Housing	11–12

8.2.5 Video Head Board [0][5]

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51910	Circuit Board	
	PU43351-106	Cap. Housing	1–6
	PU50766	Test Point	TP-GND,204,222, 223
	PX103N-070NNNCN	Wire Ass'y	for Earth

8.2.6 Tuner/IF Board Ass'y [0][6] PU10432S1

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	AN5111	Integrated Circuit	
IC 2	UPC1391H	"	
Q 1	2SC2188	Transistor	
Q 2	2SC2647B,C	"	2SC2647C
Q 3	"	"	"
Q 4	2SD637Q,R	"	2SD637R
Q 5	2SC2647B,C	"	2SC2647C
Q 6	"	"	"
⚠ Q 7	2SB641R,S	"	2SB641S
⚠ Q 8	"	"	"
⚠ Q 9	2SA1020O,Y	"	2SA1020Y
D 1	RD6.8EB3	Zener Diode	
D 2	–	–	
D 3	1SS133	Diode	
D 4	"	"	
D 5	"	"	
D 6	"	"	
D 7	–	–	
D 8	–	–	
D 9	–	–	
D10	–	–	
D11	–	–	
D12	–	–	
D13	–	–	
D14	1SS133	Diode	
R 1	QRD161J-820	CR	82
R 2	" -392	"	3.9 K
R 3	" -471	"	470
R 4	" -681	"	680
R 5	" -470	"	47
R 6	" -102	"	1 K
R 7	" -122	"	1.2 K
R 8	" -821	"	820
R 9	QVZ1802-222	VR	2.2 K (NOISE)
R10	–	–	
R11	QRD161J-222	CR	2.2 K
R12	" -181	"	180
R13	" -561	"	560
R14	" -104	"	100 K
R15	" -124	"	120 K
R16	" -222	"	2.2 K
R17	" -103	"	10 K
R18	–	–	
R19	QRD161J-223	CR	22 K
R20	–	–	
R21	QRD161J-223	CR	22 K
R22	" -332	"	3.3 K
R23	QRD181J-151	"	150
R24	QRD161J-273	"	27 K
R25	" -334	"	330 K
R26	" -103	"	10 K
R27	" -472	"	4.7 K
R28	" -681	"	680
R29	" -101	"	100
R30	" -472	"	4.7 K
R31	" -102	"	1 K
R32	" -104	"	100 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R33	QRD161J-822	CR	8.2 K
R34	QVZ1802-472	VR	4.7 K (COLOR LEV.)
R35	QRD161J-473	CR	47 K
R36	" -153	"	15 K
R37	" -471	"	470
R38	" -151	"	150
R39	" -750	"	75
R40	–	–	
R41	QRD161J-471	CR	470
R42	" -103	"	10 K
R43	" -271	"	270
R44	" -391	"	390
⚠ R45	QRZ0054-470	FR	47 1/4 W
R46	QVZ1802-103	VR	10 K (AUDIO LEV.)
R47	QRD161J-472	CR	4.7 K
R48	" -103	"	10 K
R49	" -474	"	470 K
R50	–	–	
R51	QRD161J-333	CR	33 K
R52	" -332	"	3.3 K
R53	" -151	"	150
R54	" -473	"	47 K
R55	" -103	"	10 K
R56	" -682	"	6.8 K
R57	–	–	
R58	QRD161J-223	CR	22 K
R59	" -223	"	22 K
R60	" -183	"	18 K
R61	" -103	"	10 K
R62	" -392	"	3.9 K
R63	" -153	"	15 K
R64	" -103	"	10 K
R65	" -103	"	10 K
R66	" -103	"	10 K
R67	" -222	"	2.2 K
R68	" -103	"	10 K
R69	" -102	"	1 K
R70	–	–	
R71	QRD161J-104	CR	100 K
R72	" -474	"	470 K
R73	" -223	"	22 K
R80	" -103	"	10 K
⚠ R151	PU52108-100K	Posistor	
C 1	QCF31HP-222	C Cap	0.0022 50 V
C 2	QCY31HK-222	"	0.0022 "
C 3	QCF31HP-222	"	0.0022 "
C 4	" -222	"	0.0022 "
C 5	QCY31HK-222	"	0.0022 "
C 6	QET61HR-475	E Cap	4.7 "
C 7	" -105	"	1 "
C 8	QCF31HP-222	C Cap	0.0022 "
C 9	QCT25PH-560	"	56 P
C10	–	–	
C11	QCT25CH-2R0	C Cap	2 P
C12	" -1R0	"	1 P
C13	QCS31HJ-470	"	47 P 50 V
C14	" -471	"	470 P "
C15	QCT25LH-560	"	56 P
C16	QCT25CH-100	"	10 P
C17	QET61HR-335	E Cap	3.3 50 V
C18	QCY31HK-222	C Cap	0.0022 "
C19	QFN31HK-473	MY Cap	0.047 "
C20	QET61CR-106	E Cap	10 16 V
C21	QFN61HK-473	MY Cap	0.047 50 V

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C22	QET61HR-475	E Cap	4.7 50 V
C23	QCY31HK-222	C Cap	0.0022 "
C24	QET61HR-335	E Cap	3.3 "
C25	QET61CR-476	"	47 16 V
C26	QET61CR-336	"	33 "
C27	QET61HM-475	"	4.7 50 V
C28	QCS31HJ-270	C Cap	27 P 50 V
C29	" -100	"	10 P "
C30	" -470	"	47 P "
C31	QFN31HK-102	MY Cap	0.001 "
C32	QET61AR-107	E Cap	100 10 V
C33	QET61CR-107	"	100 16 V
C34	–	–	
C35	–	–	
C36	–	–	
C37	QCS31HJ-101	C Cap	100 P 50 V
C38	–	–	
C39	–	–	
C40	–	–	
C41	QCF31HP-223	C Cap	0.022 50 V
C42	" -223	"	0.022 "
C43	QFN31HK-103	MY Cap	0.01 "
C44	QCT25CH-220	C Cap	22 P 16 V
C45	QET61CR-336	E Cap	33 "
C46	QCF31HP-223	C Cap	0.022 50 V
C47	QET61HR-105	E Cap	1 "
C48	QFN31HK-223	MY Cap	0.022 "
C49	" -223	"	0.022 "
C50	–	–	
C51	QET61CR-106	E Cap	10 16 V
C52	" -106	"	10 "
C53	–	–	
C54	–	–	
C55	–	–	
C56	–	–	
C57	–	–	
C58	–	–	
C59	–	–	
C60	QET61HM-106	E Cap	10 50 V
C61	QET61CR-106	"	10 16 V
C62	" -106	"	10 "
C63	–	–	
C64	QET61HR-225	E Cap	2.2 50 V
C65	–	–	
C66	QET61CM-227	E Cap	220 16 V
C67	–	–	
C68	–	–	
C69	–	–	
C70	–	–	
C71	QET61HR-474	E Cap	0.47 50 V
L 1	PU49994-1R0	Peaking Coil	1 μH
⚠ L 2	A04725-10	"	10 μH
L 3	" -15	"	15 μH
⚠ L 4	" -68	"	68 μH
L 5	" -33	"	33 μH
L13	PU49995-220	"	
SAW 1	PU32987-3	Saw Filter	
CF 1	–	–	
CF 2	PU32990-2	Ceramic Filter	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
CF 3	–	–	
CF 4	PU49295-2	Ceramic Filter	
CF 5	–	–	
CF 6	PU32991-2	Ceramic Filter	
T 1	PU32988-3	IF Transformer	
T 2	PU32167-4	"	(AFT)
T 3	PU32177-3	"	(P. DET)
T 4	PU33244	"	(S. TRAP)
T 5	PU51467	"	(15.625 kHz)
	PU21260	Shield Case (1)	Large
	PU21261	Shield Cover (1)	
	PU21262	Shield Plate (1)	
	PU33324	Shield Case (2)	Small
	PU33225	Shield Cover (2)	
	PU33226	Shield Plate (2)	
⚠	PU33157-3-2	V/U Tuner	
	PU45908-2	Test Pin	TP12, 14, 21, 22, GND
	PU43351-3	Cap. Housing	11–13
	" -2	"	31–32
	" -4	"	41–44
	" -10	"	21–29 and 210
	PU43351-102	"	

8.2.7 Tuner/Timer Control Board Ass'y 0 7 PU10432A2

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC201	–	–	
⚠ IC202	MN1204E	Integrated Circuit	
IC203	MB3761M	"	
IC204	UPC358C	"	
IC205	MN1218A	"	
⚠ IC206	MB8851AM-143L	"	
⚠ IC207	UPD552C-088	"	
IC208	IR2403	"	
IC209	"	"	
IC210	–	–	
IC211	UPD4029C	Integrated Circuit	
IC212	IR2403	"	
Q201	2SD637R	Transistor	
Q202	"	"	
⚠ Q203	2SB643R	"	
⚠ Q204	2SC1983R	"	
D201	–	–	
D202	10E2	Diode	
D203	"	"	
D204	–	–	
D205	HZ6A-1L	Zener Diode	
D206	1SS133	Diode	
D207	"	"	
D208	"	"	
D209	HZ6B-3	Zener Diode	
D210	–	–	
D211	1SS133	Diode	
D212	"	"	
D213	"	"	
D214	SLP-135B	LED	
D215	1SS133	Diode	
D216	"	"	
D217	"	"	
D218	–	–	
D219	1SS133	Diode	
D220	–	–	
D221	1SS133	Diode	
D222	"	"	
D223	"	"	
RA201	EXB-P85333M or FRE5333M	Resistor Array	EXB-P85333M
RA202	"	"	"
RA203	EXB-P84333M or FRE4333M	"	EXB-P84333M
RA204	EXB-P811562M or FRE11562M	"	EXB-P8 11562M
RA205	EXB-P812333M or FRE12333M	"	EXB-P8 12333M
RA206	EXB-P89333M or FRE9333M	"	EXB-P89333M
RA207	EXB-P84333M FRE4333M	"	EXB-P84333M

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R201	–	–	
R202	QRD161J-102	CR	1 K
R203	" -153	"	15 K
R204	" -153	"	15 K
R205	" -153	"	15 K
R206	" -153	"	15 K
R207	" -224	"	220 K
R208	" -564	"	560 K
R209	" -222	"	2.2 K
R210	–	–	
R211	QRD161J-124	CR	120 K
R212	" -154	"	150 K
R213	" -124	"	120 K
R214	" -103	"	10 K
R215	" -223	"	22 K
R216	" -103	"	10 K
R217	" -333	"	33 K
R218	" -103	"	10 K
R219	" -224	"	220 K
R220	–	–	
R221	QRD161J-682	CR	6.8 K
R222	" -103	"	10 K
R223	" -273	"	27 K
R224	" -103	"	10 K
R225	" -123	"	12 K
R226	" -394	"	390 K
R227	" -333	"	33 K
R228	" -333	"	33 K
R229	" -103	"	10 K
R230	–	–	
R231	QRD161J-222	CR	2.2 K
R232	" -393	"	39 K
R233	" -393	"	39 K
R234	PU51952	Tuning VR	Incl. S203
R235	QRD161J-223	CR	22 K
R236	" -223	"	22 K
R237	" -103	"	10 K
R238	" -123	"	12 K
R239	" -183	"	18 K
R240	–	–	
R241	QRD161J-333	CR	33 K
R242	" -333	"	33 K
R243	" -333	"	33 K
R244	" -333	"	33 K
R245	" -333	"	33 K
R246	" -333	"	33 K
R247	" -101	"	100
R248	" -104	"	100 K
R249	–	–	
R250	–	–	
R251	QRD161J-102	CR	1 K
R252	" -222	"	2.2 K
R253	" -224	"	220 K
R254	" -472	"	4.7 K
R255	" -104	"	100 K
R256	" -333	"	33 K
R257	QRD187J-102	"	1 K
R258	QRD161J-104	"	100 K
R259	" -103	"	10 K
R260	–	–	
R261	QRD161J-103	CR	10 K
R262	" -102	"	1 K
R263	" -561	"	560
R264	" -561	"	560
R265	" -561	"	560

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R266	QRD161J-561	CR	560
R267	–	–	
R268	QRD161J-103	CR	10 K
R269	" -101	"	100
R270	–	–	
R271	QRD161J-333	CR	33 K
R272	" -391	"	390
R273	–	–	
R274	QRD161J-102	CR	1 K
R275	–	–	
R276	QRD161J-102	CR	1 K
R277	" -102	"	1 K
R278	" -103	"	10 K
R279	" -102	"	1 K
C201	QET61HR-107	E Cap	100 50 V
C202	QFN31HK-333	MY Cap	0.033 "
C203	" -333	"	0.033 "
C204	" -333	"	0.033 "
C205	" -333	"	0.033 "
C206	" -223	"	0.022 "
C207	" -563	"	0.056 "
C208	–	–	
C209	QET61HR-105	E Cap	1 50 V
C210	–	–	
C211	QET61HR-474	E Cap	0.47 50 V
C212	QCS31HJ-151	C Cap	150 P "
C213	" -471	"	470 P "
C214	" -471	"	470 P "
C215	QET61ER-475	E Cap	4.7 25 V
C216	QET61HR-225	"	2.2 50 V
C217	QET61CR-106	"	10 16 V
C218	QET61JR-107	"	100 63 V
C219	QFN31HK-563	MY Cap	0.056 50 V
C220	–	–	
C221	QFN31HK-563	MY Cap	0.056 50 V
C222	QET61HR-225	E Cap	2.2 "
C223	QFN31HK-563	MY Cap	0.056 "
C224	QET61CR-477	E Cap	470 16 V
C225	QFN31HK-563	MY Cap	0.056 50 V
C226	" -154	"	0.15 "
C227	" -393	"	0.039 "
C228	QET61HR-225	E Cap	2.2 "
C229	QCT25CH-100	C Cap	10 P
C230	–	–	
C231	–	–	
C232	QCT25CH-150	C Cap	15 P
C233	QAT3001-011	TR Cap	10 P (3.84 MHz)
C234	QFN31HK-103	MY Cap	0.01 50 V
C235	QET61CR-106	E Cap	10 16 V
C236	QCS31HJ-121	C Cap	120 P 50 V
C237	" -221	"	220 P "
C238	QFN31HK-104	MY Cap	0.1 "
C239	QET61AR-476	E Cap	47 10 V
C240	–	–	
C241	–	–	
C242	–	–	
C243	QCF11HP-473	C Cap	0.047 50 V
C244	QCS11HJ-101	"	100 P "
L201	PU46003-151	Peaking Coil	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ CP 1	ICP-F10	Circuit Protector	
X'tal 201	PU51640	Crystal	
CF201	PU50224	Ceramic Filter	
S201	QSS2301-401	Slide Switch	CH PRESET
S202	QSS1201-025	″	AFT
S203	—	Switch	See R234
	PU43351-104	Cap. Housing	11–14
	″ -7	″	21–27
	″ -9	″	31–39
	″ -3	″	41–43
	″ -5	″	51–55
	″ -6	″	61–66
	″ -8	″	71–78
	″ -10	″	81–810
	″ -7R	″	91–97
	PU45908-2	Test Pin	TP201–205
	PU50634	LED Spacer	for D214

8.2.8 Display Board Ass'y $\boxed{0}\boxed{8}$ PU21421A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ IC401	UPD552C-079	Integrated Circuit	
D401	SLR54MT4	LED	
D402	″	″	
D403	″	″	
D404	″	″	
D405	″	″	
D406	″	″	
D407	″	″	
D408	″	″	
D409	″	″	
D410	″	″	
D411	″	″	
D412	″	″	
D413	—	—	
D414	—	—	
D415	—	—	
D416	—	—	
D417	TLS124	LED	
D418	″	″	
D419	″	″	
D420	″	″	
RA401	EXB-P88333M	Resistor Array	33 K x 8
RA402	″	″	″
RA403	EXB-P811563M	″	56 K x 11
RA404	″	″	″
R401	QRD181J-564	CR	560 K
C401	QET61CM-476	E Cap	47 16 V
C402	QFN31HK-103	MY Cap	0.01 50 V
C403	QCS41HJ-121	C Cap	120 P ″
C404	QCY61HK-471	″	470 P ″
CF401	PU53580	Ceramic Filter	
S401	PU53848	Push Switch	
S402	″	″	
S403	″	″	
S404	PU52956	″	
S405	PU53848	″	
S406	″	″	
S407	″	″	
S408	″	″	
S409	″	″	
S410	″	″	
S411	PU52956	″	
S412	″	″	
S413	″	″	
S414	″	″	
S415	″	″	
S416	″	″	
S417	″	″	
S418	″	″	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
S419	PU52956	Push Switch	
S420	"	"	
S421	"	"	
S422	"	"	
	PU51911-2	F. Display	
	PU51907A	F.D. Holder Ass'y	
P 1	PU43351-105	Cap. Housing	11–15
P 2	" -6	"	21–26
P 3	" -4	"	31–34
P 4	" -7	"	41–47
P 5	" -8	"	51–58
P 6	" -5	"	61–65
	PU33140	LED Spacer	for D401–412
	PU33141	LED Shade	for "
	PU52348	LED Spacer	for D417–420
	PU43192-4	Binder	

8.2.9 Color Board Ass'y [0][9] PU10586A2

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC501	BA7200	Integrated Circuit	
IC502	BA7007	"	
IC503	AN607P	"	
IC504	AN607P	"	
⚠IC601	HA11741	Integrated Circuit	
IC602	BA7007	"	
IC603	UPD4066BC	"	
IC604	"	"	
⚠IC605	"	"	
IC606	BA7001	"	
Q501	2SC2021Q,R,S	Transistor	2SC2021S
Q502	"	"	"
Q503	"	"	"
Q504	"	"	"
Q505	2SC2021Q	"	
Q506	"	"	
Q507	2SC2021Q,R,S	"	2SC2021S
Q508	2SC2021Q	"	
Q601	2SC2021Q	Transistor	
Q602	2SC2021Q,R,S	"	2SC2021S
Q603	2SC2021Q	"	
Q604	"	"	
Q605	2SC2021Q,R,S	"	2SC2021S
Q606	–	–	"
Q607	2SC2021Q	Transistor	
Q608	2SC2021Q,R,S	"	2SC2021S
Q609	"	"	"
Q610	2SC2021Q	"	
Q611	"	"	
Q612	"	"	
Q613	"	"	
Q614	"	"	
D501	1SS133	Diode	
D502	"	"	
D503	"	"	
D504	–	–	
D505	1SS133	Diode	
D506	"	"	
D507	1SS99	"	
D508	"	"	
D509	1SS133	"	
D601	1SS133	Diode	
D602	–	–	
D603	1SS133	Diode	
D604	–	–	
D605	1SS133	Diode	
D606	"	"	
R501	QRD161J-102	CR	1 K
R502	" -102	"	1 K
R503	" -102	"	1 K
R504	" -102	"	1 K
R505	" -472	"	4.7 K
R506	" -182	"	1.8 K
R507	" -102	"	1 K
R508	" -331	"	330
R509	" -473	"	47 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R510	QRD161J-223	CR	22 K
R511	″ -223	″	22 K
R512	″ -473	″	47 K
R513	″ -393	″	39 K
R514	″ -223	″	22 K
R515	″ -473	″	47 K
R516	″ -331	″	330
R517	″ -391	″	390
R518	″ -102	″	1 K
R519	″ -682	″	6.8 K
R520	″ -822	″	8.2 K
R521	″ -102	″	1 K
R522	″ -102	″	1 K
R523	″ -562	″	5.6 K
R524	″ -562	″	5.6 K
R525	″ -223	″	22 K
R526	″ -223	″	22 K
R527	″ -473	″	47 K
R528	ERTD2FHL-202S	Thermistor	2 K
R529	QRD161J-272	CR	2.7 K
R530	″ -182	″	1.8 K
R531	″ -332	″	3.3 K
R532	″ -102	″	1 K
R533	″ -102	″	1 K
R534	″ -823	″	82 K
R535	″ -183	″	18 K
R536	″ -181	″	180
R537	″ -222	″	2.2 K
R538	″ -681	″	680
R539	″ -393	″	39 K
R540	″ -333	″	33 K
R541	″ -391	″	390
R542	″ -681	″	680
R543	QVZ3506-102	VR	1 K (S. P.B COL.)
R544	QRD161J-182	CR	1.8 K
R545	QVZ3506-471	VR	470 (S. REC. COL.)
R546	QRD161J-220	CR	22
R547	″ -184	″	180 K
R548	″ -392	″	3.9 K
R549	″ -682	″	6.8 K
R550	″ -102	″	1 K
R551	″ -102	″	1 K
R552	″ -104	″	100 K
R553	″ -182	″	1.8 K
R554	QVZ3506-472	VR	4.7 K (S. DET)
R555	QRD161J-103	CR	10 K
R556	″ -562	″	5.6 K
R557	″ -333	″	33 K
R558	″ -393	″	39 K
R559	″ -181	″	180
R560	″ -102	″	1 K
R561	″ -393	″	39 K
R562	–	–	
R564	QRD161J-181	CR	180
R565	″ -181	″	180
R601	″ -272	″	2.7 K
R602	″ -153	″	15 K
R603	″ -471	″	470
R604	″ -393	″	39 K
R605	″ -393	″	39 K
R606	″ -333	″	33 K
R607	″ -333	″	33 K
R608	″ -393	″	39 K
R609	″ -472	″	4.7 K
R610	″ -274	″	270 K
R611	QVZ3506-223	VR	22 K (VXO (2))

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R612	QRD161J-472	CR	4.7 K
R613	″ -102	″	1 K
R614	″ -102	″	1 K
R615	″ -562	″	5.6 K
R616	QVZ3506-681	VR	680 (P. P.B. COL.)
R617	–	–	
R618	QRD161J-392	CR	3.9 K
R619	″ -392	″	3.9 K
R620	″ -564	″	560 K
R621	QVZ3506-472	VR	4.7 K (P. CONV. BAL.)
R622	QRD161J-562	CR	5.6 K
R623	″ -471	″	470
R624	QVZ3506-103	VR	10 K (P. AFC)
R625	QRD161J-821	CR	820
R626	″ -272	″	2.7 K
R627	″ -123	″	12 K
R628	″ -471	″	470
R629	″ -471	″	470
R630	″ -562	″	5.6 K
R631	″ -122	″	1.2 K
R632	″ -331	″	330
R633	QRG129J-331	OMF R	330
R634	QRD161J-392	CR	3.9 K
R635	″ -392	″	3.9 K
R636	″ -333	″	33 K
R637	″ -102	″	1 K
R638	″ -102	″	1 K
R639	″ -122	″	1.2 K
R640	″ -681	″	680
R641	″ -271	″	270
R642	″ -103	″	10 K
R643	″ -103	″	10 K
R644	″ -223	″	22 K
R645	″ -223	″	22 K
R646	″ -122	″	1.2 K
R647	″ -273	″	27 K
R648	″ -562	″	5.6 K
R649	″ -181	″	180
R650	″ -152	″	1.5 K
R651	″ -181	″	180
R652	″ -681	″	680
R653	″ -821	″	820
R654	″ -393	″	39 K
R655	″ -333	″	33 K
R656	″ -272	″	2.7 K
R657	″ -102	″	1 K
R658	″ -103	″	10 K
R659	″ -103	″	10 K
R660	″ -181	″	180
R661	″ -222	″	2.2 K
R662	″ -222	″	2.2 K
R663	″ -103	″	10 K
R664	″ -103	″	10 K
R665	″ -562	″	5.6 K
R666	″ -123	″	12 K
R667	″ -562	″	5.6 K
R668	″ -222	″	2.2 K
R669	″ -221	″	220
R670	″ -102	″	1 K
R671	QVZ3506-102	VR	1 K (N.(M) REC. COL.)
R672	QRD161J-223	CR	22 K
R673	″ -223	″	22 K
R674	″ -681	″	680
R675	″ -331	″	330
R676	″ -151	″	150

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R677	–	–	
R678	–	–	
R679	–	–	
R680	–	–	
R681	QRD161J-563	CR	56 K
R682	〃 -182	〃	1.8 K
R683	QVZ3506-472	VR	4.7 K (S.(M) DET.)
R684	QRD161J-103	CR	10 K
R685	〃 -562	〃	5.6 K
R686	〃 -333	〃	33 K
R687	〃 -393	〃	39 K
R688	–	–	
R689	QRD161J-181	CR	180
R690	〃 -102	〃	1 K
R691	〃 -393	〃	39 K
R692	–	–	
R693	QRD161J-181	CR	180
R694	〃 -181	〃	180
R695	〃 -104	〃	100 K
R696	–	–	
R697	–	–	
R698	QRD161J-104	CR	100 K
R699	〃 -272	〃	2.7 K
R700	QVZ3506-102	VR	1 K (N. P.B COL.)
R701	QRD161J-123	CR	12 K
R702	〃 -682	〃	6.8 K
R703	–	–	
R704	–	–	
C501	QCF31HP-103	C Cap	0.01 50 V
C502	〃 -103	〃	0.01 〃
C503	〃 -103	〃	0.01 〃
C504	QET61AR-476	E Cap	47 10 V
C505	〃 -476	〃	47 〃
C506	QCS31HJ-220	C Cap	22 P 50 V
C507	QCS11HJ-2R0	〃	2 P 〃
C508	QCF31HP-223	〃	0.022 〃
C509	QET61AR-476	E Cap	47 10 V
C510	QCS11HJ-2R0	C Cap	2 P 50 V
C511	QET61AR-476	E Cap	47 10 V
C512	〃 -476	〃	47 〃
C513	QFP42AJ-222	PP Cap	0.0022 100 V
C514	QCF31HP-223	C Cap	0.022 50 V
C515	QFN31HJ-104	MY Cap	0.1 〃
C516	QCS31HJ-181	C Cap	180 P 〃
C517	QCF31HP-103	〃	0.01 〃
C518	QCS31HJ-101	〃	100 P 〃
C519	QFN31HJ-103	MY Cap	0.01 〃
C520	〃 -103	〃	0.01 〃
C521	QCF31HP-223	C Cap	0.022 〃
C522	QET61AR-476	E Cap	47 10 V
C523	QFN31HJ-103	MY Cap	0.01 50 V
C524	QCF11HP-103	C Cap	0.01 50 V
C525	QFN31HJ-103	MY Cap	0.01 50 V
C526	QCF31HP-103	C Cap	0.01 〃
C527	QET61AR-476	E Cap	47 10 V
C528	〃 -476	〃	47 〃
C529	QCS31HJ-331	C Cap	330 P 50 V
C530	QCF31HP-103	〃	0.01 〃
C531	〃 -102	〃	0.001 〃
C532	〃 -103	〃	0.01 〃
C533	QFN31HJ-473	MY Cap	0.047 〃
C534	QET61HR-225	E Cap	2.2 〃

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C535	QET61HR-225	E Cap	2.2 50 V
C536	QCF31HP-103	C Cap	0.01 〃
C537	QCS31HJ-330	〃	33 P 〃
C538	QCF31HP-103	〃	0.01 〃
C539	QET61AR-476	E Cap	47 10 V
C540	QCF31HP-223	C Cap	0.022 50 V
C541	QET61AR-336	E Cap	33 10 V
C542	QET61HR-105	〃	1 50 V
C543	QCF31HP-102	C Cap	0.001 〃
C544	QET61AR-476	E Cap	47 10 V
C545	QCF31HP-223	C Cap	0.022 50 V
C546	–	–	
C547	QET61CR-106	E Cap	10 16 V
C548	QCF31HP-103	C Cap	0.01 50 V
C549	〃 -103	〃	0.01 〃
C551	QCS11HJ-390	C Cap	39 P
C552	QCF31HP-223	〃	0.022 50 V
C553	QET61AR-476	E Cap	47 10 V
C554	QCF31HP-223	C Cap	0.022 50 V
C601	QCS31HJ-100	〃	10 P 50 V
C602	QAT3001-009	TR Cap	(P. VXO(1))
C603	QCS31HJ-471	C Cap	470 P 50 V
C604	〃 -471	〃	470 P 〃
C605	〃 -101	〃	100 P 〃
C606	QET61AR-476	E Cap	47 16 V
C607	QCF31HP-223	C Cap	0.022 50 V
C608	〃 -223	〃	0.022 〃
C609	QET61AR-476	E Cap	47 10 V
C610	QCF31HP-223	C Cap	0.022 50 V
C611	〃 -223	〃	0.022 〃
C612	QET61ER-475	E Cap	4.7 25 V
C613	QCF31HP-103	C Cap	0.01 50 V
C614	〃 -103	〃	0.01 〃
C615	QET61ER-476	E Cap	47 25 V
C616	QCF31HP-103	C Cap	0.01 50 V
C617	QEE41CM-106	T Cap	10 16 V
C618	QFN31HJ-472	MY Cap	0.0047 50 V
C619	QCF31HP-103	C Cap	0.01 〃
C620	〃 -103	〃	0.01 〃
C621	QET61HR-225	E Cap	2.2 〃
C622	QCF31HP-103	C Cap	0.01 〃
C623	QCS31HJ-820	〃	82 P 〃
C624	QCT25CH-270	〃	27 P
C625	〃 -220	〃	22 P
C626	QFN31HJ-473	MY Cap	0.047 50 V
C627	QET61HR-335	E Cap	3.3 25 V
C628	QFN31HJ-333	MY Cap	0.033 50 V
C629	QET61ER-335	E Cap	3.3 16 V
C630	QET61HR-475	〃	4.7 50 V
C631	QCS31HJ-391	C Cap	390 〃
C632	QFN31HJ-332	MY Cap	0.0033 〃
C633	QCF31HP-103	C Cap	0.01 〃
C634	〃 -103	〃	0.01 〃
C635	QET61HM-224	E Cap	0.22 〃
C636	QCF31HP-103	C Cap	0.01 〃
C637	–	–	
C638	QCF31HP-103	C Cap	0.01 50 V
C639	QET61AR-476	E Cap	47 10 V
C640	QCF31HP-223	C Cap	0.022 50 V
C641	〃 -103	〃	0.01 〃
C642	〃 -103	〃	0.01 〃
C643	〃 -103	〃	0.01 〃
C644	QET61CR-476	E Cap	47 16 V
C645	QCF31HP-223	C Cap	0.022 50 V
C646	〃 -103	〃	0.01 〃
C647	〃 -103	〃	0.01 〃
C648	–	–	
C649	QET61AR-476	E Cap	47 10 V

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C650	QCF31HP-223	C Cap	0.022 50 V
C651	" -103	"	0.01 "
C652	" -103	"	0.01 "
C653	" -103	"	0.01 "
C654	" -103	"	0.01 "
C655	–	–	
C656	QET61AR-476	E Cap	47 10 V
C657	QCF31HP-223	C Cap	0.022 50 V
C658	QET61AR-476	E Cap	47 10 V
C659	QCF31HP-223	C Cap	0.022 50 V
C660	QET61AR-336	E Cap	33 10 V
C661	QCF31HP-122	C Cap	0.0012 50 V
C662	QET61HR-105	E Cap	1 "
C663	QET61AR-476	"	47 10 V
C664	QCF31HP-123	C Cap	0.012 50 V
C665	–	–	
C666	QET61CR-106	E Cap	10 16 V
C667	QCF31HP-103	C Cap	0.01 50 V
C668	" -223	"	0.022 "
C669	QET61AR-476	E Cap	47 10 V
C670	–	–	
C671	QCF31HP-223	C Cap	0.022 50 V
C672	–	–	
C673	–	–	
C674	QCF31HP-103	C Cap	0.01 50 V
C675	–	–	
C676	QFN31HJ-563	MY Cap	0.056 50 V
C677	–	–	
C678	QCF31HJ-103	C Cap	0.01 50 V
C679	QET61AR-476	E Cap	47 10 V
C680	QCS11HJ-270	C Cap	27 P 50 V
C681	QCF11HP-223	C Cap	0.022 50 V
L501	PU52741	Coil	
L502	PU52742	"	
L503	PU49057	"	
⚠ L504	PU48530-101K	"	100 μH
L505	" -560J	"	56 μH
L506	PU47051-333	"	33 mH
⚠ L507	PU48530-101K	"	100 μH
L508	PU53223-390TL	"	39 μH
L601	PU49057	"	
⚠ L602	PU48530-101K	"	100 μH
⚠ L603	" -101K	"	100 μH
⚠ L604	" -101K	"	100 μH
⚠ L605	" -101K	"	100 μH
⚠ L606	" -101K	"	100 μH
L607	PU47051-123	"	12 mH
L608	" -822	"	8.2 mH
L609	PU53223-680TL	"	68 μH
DL601	PU51221	2H Delay Line	
DL602	PU54311	1H Delay Line	
HPF501	PU51791	High-Pass Filter	
LPF601	PU50747-2	Low-Pass Filter	
BPF501	PU51790	Band-Pass Filter	
BPF502	PU49406	"	
BPF503	PU52743	"	
BPF601	PU49465	Band-Pass Filter	
BPF602	PU32489	"	
CF501	PU46521	Ceramic Filter	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
CF601	PU46521	Ceramic Filter	
EQ501	PU52168	Equalizer	
X601	PU31449-7	Crystal	
X602	" -4	"	
	PU43351-3	Cap. Housing	(11–13)
	" -4	"	(21–24)
	" -5	"	(31–35)
	" -2	"	(41–42)
	" -2	"	(51–52)
	" -2	"	(61–62)
	" -2	"	(71–72)
	" -2R	"	(81–82)
	" -3Y	"	(91–93)
	" -2	"	(101–102)
	" -2Y	"	(111–112)
	" -2R	"	(121–122)
	" -2R	"	(131–132)
	" -3R	"	(141–143)
	" -3	"	(151–153)
	" -4R	"	(161–164)
	" -2Y	"	(171–172)
	" -2	"	(181–182)
	" -2	"	(191–192)
	" -2	"	(201–202)
	PU50766	Test Pin	TP-GND, 501, 502, 505, 521, 522, 523 TP-603, 606, 612, 621, 622, 623, 624

8.2.10 Regulator Board Ass'y $\boxed{1}\boxed{0}$ PU21268E

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ Q 1	2SD637S	Transistor	
Q 2	–	–	
Q 3	2SD639R,S	Transistor	2SD639S
Q 4	2SD637R,S	"	2SD637S
⚠ Q 5	2SD637S	"	
Q 6	–	–	
Q 7	2SD637S	Transistor	
⚠ Q 8	"	"	
⚠ Q 9	2SD895D,E	"	2SD895E
Q10	2SD639R,S	"	2SD639S
Q11	2SC2655O,Y	"	2SC2655Y
⚠ DS 1	D5FB10	Diode Stack	
⚠ DS 2	"	"	
D 1	–	–	
D 2	–	–	
D 3	–	–	
D 4	–	–	
D 5	HZ12C-3L	Zener Diode	
D 6	1S2076A	Diode	
D 7	HZ7A-1L	Zener Diode	
D 8	10E2FA-8	Diode	
⚠ D 9	V03C	"	
⚠ D10	"	"	
⚠ D11	"	"	
⚠ D12	"	"	
D13	HZ12C-3L	Zener Diode	
D14	1S2076A	Diode	
R 1	–	–	
R 2	QRD181J-182	CR	1.8 K
R 3	" -470	"	47
R 4	" -153	"	15 K
R 5	" -472	"	4.7 K
R 6	" -223	"	22 K
R 7	" -153	"	15 K
R 8	" -472	"	4.7 K
R 9	–	–	
R10	–	–	
R11	QRD181J-182	CR	1.8 K
R12	" -182	"	1.8 K
R13	" -821	"	820
R14	" -102	"	1 K
R15	QVZ3244-102	VR	1 K (12 V ADJ.)
R16	QRD181J-222	CR	2.2 K
R17	" -222	"	2.2 K
R18	" -470	"	47
R19	" -223	"	22 K
R20	" -472	"	4.7 K
R21	" -181	"	180
R22	" -472	"	4.7 K
R23	" -222	"	2.2 K
C 1	–	–	
⚠ C 2	QCF32HP-103	C Cap	0.01 500 V
⚠ C 3	" -103	"	0.01 "

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ C 4	QCF32HP-103	C Cap	0.01 500 V
⚠ C 5	" -103	"	0.01 "
⚠ C 6	QFH52AM-224	MM Cap	0.22 100 V
⚠ C 7	QEL71ER-478	E Cap	4700 25 V
C 8	QET61CR-476	"	47 16 V
C 9	" -476	"	47 "
C10	–	–	
⚠ C11	QCF32HP-103	C Cap	0.01 500 V
⚠ C12	" -103	"	0.01 "
⚠ C13	" -103	"	0.01 "
⚠ C14	" -103	"	0.01 "
⚠ C15	QFH52AM-224	MM Cap	0.22 100 V
⚠ C16	QEL71VR-478	E Cap	4700 35 V
C17	QET61VR-107	"	100 "
C18	QFN31HK-103	MY Cap	0.01 50 V
C19	" -562	"	0.0056 "
C20	QET61CR-227	E Cap	220 16 V
⚠ C21	QCF32HP-103	C Cap	0.01 500 V
⚠ C22	" -103	"	0.01 "
⚠ C23	" -103	"	0.01 "
⚠ C24	" -103	"	0.01 "
⚠ C25	QFH52AM-224	MM Cap	0.22 100 V
⚠ C26	QEL71VR-478	E Cap	4700 35 V
C27	QET61CR-476	"	47 16 V
C28	" -106	"	10 "
⚠ RY 1	PU51258	Relay	
⚠	PU51212	Fuse Clip	for F2—F4 and F6
	PU50597-06	Cap. Housing	11–16
	PU43351-2R	"	31–32
	" -3R	"	51–53
	" -3	"	61–63
	" -3R	"	71–73
	" -5	"	81–85
	" -2	"	91–92
	" -6	"	101–106
	" -3Y	"	121–123
	A74138-1	Test Pin	TP1–TP4
	PU43192-4	Binder	
F 2	–	Fuse (T2A)	See Section 7.2.3.
F 3	–	" (T2.5A)	"
F 4	–	" (T2.5A)	"
F 5	–	–	
F 6	–	Fuse (T1.25A)	See Section 7.2.3.

8.2.11 NTSC Color Board Ass'y 1 1 .... PU21468A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC401	HA11741	Integrated Circuit	
Q401	2SC2021Q	Transistor	
Q402	"	"	
Q403	2SC2021Q,R,S	"	2SC2021S
Q404	"	"	"
Q405	2SC2021Q	"	
Q406	–	–	
D401	1SS133	Diode	
D402	–	–	
D403	1SS133	Diode	
D404	"	"	
D405	"	"	
D406	"	"	
D407	"	"	
R401	–	–	
R402	QRD161J-221	CR	220
R403	" -123	"	12 K
R404	QVZ3244-472	VR	4.7 K (CONV. BAL.)
R405	QRD161J-682	CR	6.8 K
R406	" -564	"	560 K
R407	" -562	"	5.6 K
R408	QVZ3244-223	VR	22 K (VXO)
R409	QRD161J-274	CR	270 K
R410	" -223	"	22 K
R411	" -821	"	820
R412	" -562	"	5.6 K
R413	" -122	"	1.2 K
R414	" -471	"	470
R415	" -152	"	1.5 K
R416	" -562	"	5.6 K
R417	" -103	"	10 K
R418	" -103	"	10 K
R419	QVZ3244-103	VR	10 K (AFC)
R420	QRD161J-472	CR	4.7 K
R421	" -332	"	3.3 K
R422	" -123	"	12 K
R423	" -562	"	5.6 K
R424	" -222	"	2.2 K
R425	" -101	"	100
R426	" -123	"	12 K
R427	" -562	"	5.6 K
R428	" -393	"	39 K
R429	" -333	"	33 K
R430	" -393	"	39 K
R431	" -333	"	33 K
R432	–	–	
R433	–	–	
R434	QRD161J-471	CR	470
R435	" -471	"	470
R436	" -562	"	5.6 K
R437	" -122	"	1.2 K
R438	" -472	"	4.7 K
R439	" -151	"	150
R440	QRG129J-391	OMR	390
R441	QRD161J-683	CR	68 K
R442	" -102	"	1 K
R443	" -102	"	1 K
R444	" -681	"	680
R445	" -821	"	820
R446	QRD161J-102	CR	1 K
R447	" -102	"	1 K
R448	" -223	"	22 K
R449	" -223	"	22 K
R450	" -181	"	180
R451	" -221	"	220
R452	QVZ3244-472	VR	4.7 K (REC. COL. LEV.)
R453	QRD161J-680	CR	680
R454	" -392	"	3.9 K
R455	" -103	"	1 K
R456	–	–	
C401	QFN31HJ-103	MY Cap	0.01 50 V
C402	QCS31HJ-220	C Cap	22 P "
C403	QFN31HJ-103	MY Cap	0.01 "
C404	QCF31HP-103	C Cap	0.01 "
C405	–	–	
C406	QCF31HP-223	C Cap	0.022 50 V
C407	" -223	"	0.022 "
C408	QET61ER-475	E Cap	4.7 25 V
C409	QFN31HJ-473	MY Cap	0.047 50 V
C410	QCF31HP-103	C Cap	0.01 "
C411	" -103	"	0.01 "
C412	QET61AR-476	E Cap	47 10 V
C413	QCF31HP-223	C Cap	0.022 50 V
C414	QFN31HJ-472	MY Cap	0.0047 "
C415	QET61HR-225	E Cap	2.2 "
C416	QCF31HP-103	C Cap	0.01 "
C417	–	–	
C418	–	–	
C419	–	–	
C420	QCS31HJ-820	C Cap	82 P 50 V
C421	QCT25CH-220	"	22 P
C422	" -270	"	27 P
C423	QET61ER-475	E Cap	4.7 25 V
C424	QFN31HJ-473	MY Cap	0.047 50 V
C425	QCS31HJ-391	C Cap	390 P "
C426	QET61HR-225	E Cap	2.2 "
C427	QET61CR-106	"	10 16 V
C428	QCF31HP-103	C Cap	0.01 50 V
C429	" -103	"	0.01 "
C430	QET61HR-224	E Cap	0.22 "
C431	QCF31HP-103	C Cap	0.01 "
C432	" -103	"	0.01 "
C433	" -103	"	0.01 "
C434	QFN31HJ-333	MY Cap	0.033 "
C435	" -333	"	0.033 "
C436	" -333	"	0.033 "
C437	QET61AR-476	E Cap	47 10 V
C438	QCF31HP-223	C Cap	0.022 50 V
C439	QET61AR-476	E Cap	47 10 V
C440	QCF11HP-223	C Cap	0.022 50 V
L401	PU48530-101K	Coil	100 µH
L402	" -470J	"	47 µH
BPF401	PU54458	Filter	
BPF402	PU54459	"	
LPF401	PU50747	Filter	
DL401	PU50723-3	1H Delay Line	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
X401	PU47931-2	Crystal	
IB401	PU33106-039	Inline Block	
	PU43351-4	Cap. Housing	(11–14)
	" -3	"	(21–23)
	" -2	"	(31–32)
	" -2R	"	(41–42)
	" -2	"	(51–52)
	" -4	"	(61–64)
	" -2Y	"	(71–72)
	" -2	"	(81–82)
	PU50766	Test Point	TP-403, 404, 412, 421, 422, GND

8.2.12 Mechacon Board Ass'y $\boxed{1}\boxed{2}$ PU10477A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	M51014L	Integrated Circuit	
⚠ IC 2	M50127AP	"	
IC 3	M50786SP or M50782SP	"	M50786SP
IC 4	M50786SP or TMS1025N2LL	"	M50786SP
⚠ IC 5	UPD553C-210 or UPD553C-185	"	UPD553C-210
IC 6	UPC339C	"	
IC 7	M54519P	"	
IC 8	"	"	
IC 9	"	"	
IC10	UPD4050C	"	
⚠ IC11	M54519P	"	
IC12	"	"	
⚠ IC13	"	"	
IC14	M54532P	"	
⚠ Q 1	2SA1020O,Y	Transistor	2SA1020Y
⚠ Q 2	"	"	"
⚠ Q 3	"	"	"
⚠ Q 4	"	"	"
⚠ Q 5	"	"	"
⚠ Q 6	"	"	"
⚠ Q 7	"	"	"
⚠ Q 8	"	"	"
⚠ Q 9	"	"	"
⚠ Q10	2SC2655O,Y	"	2SC2655Y
⚠ Q11	"	"	"
Q12	2SB641Q	Transistor	
Q13	"	"	
⚠ Q14	2SC2877O,Y	"	2SC2877Y
⚠ Q15	"	"	"
Q16	2SD637R	"	
Q17	"	"	
⚠ Q18	2SC3070	"	
⚠ Q19	"	"	
Q20	2SD637R	"	
Q21	–	–	
Q22	2SB641Q	Transistor	
Q23	2SK34C	FET	
D 1	PH302	Photo Diode	for Infrared Receiver
D 2	1S2473	Diode	
D 3	"	"	
D 4	"	"	
D 5	"	"	
D 6	"	"	
D 7	"	"	
D 8	"	"	
D 9	"	"	
D10	"	"	
D11	"	"	
D12	"	"	
D13	"	"	
D14	"	"	
D15	"	"	
D16	W03C	"	
D17	"	"	
D18	"	"	
D19	"	"	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
D20	W03C	Diode	
D21	"	"	
D22	"	"	
D23	"	"	
D24	HZ9B-3L	Zener Diode	
D25	HZ16-2L	"	
D26	HZ7B-2L	"	
D27	1S2473	Diode	
D28	—	—	
D29	1S2473	Diode	
D30	"	"	
D31	—	—	
D32	—	—	
D33	1S2473	Diode	
D34	HZ12C-3L	Zener Diode	
D35	—	—	
D36	1S2473	Diode	
D37	"	"	
D38	"	"	
RA 1	EXB-P84333M	Resistor Array	
RA 2	"	"	
RA 3	"	"	
RA 4	"	"	
RA 5	EXB-P812333M	"	
RA 6	EXB-LD6103G	"	
R 1	QRD181J-102	CR	1 K
R 2	" -104	"	100 K
R 3	QRD142J-102	"	1 K 1/4 W
R 4	" -102	"	1 K "
R 5	QRD181J-223	"	22 K
R 6	" -473	"	47 K
R 7	" -333	"	33 K
R 8	" -334	"	330 K
R 9	" -473	"	47 K
R10	" -101	"	100
R11	" -272	"	2.7 K
R12	" -223	"	22 K
R13	" -273	"	27 K
R14	" -223	"	22 K
R15	" -104	"	100 K
R16	" -103	"	10 K
R17	" -104	"	100 K
R18	" -103	"	10 K
R19	" -564	"	560 K
R20	" -102	"	1 K
R21	" -333	"	33 K
R22	" -104	"	100 K
R23	" -333	"	33 K
R24	QRV147F-103S	MFR	10 K 1/4 W
R25	QRD181J-103	CR	10 K
R26	" -104	"	100 K
R27	" -103	"	10 K
R28	" -104	"	100 K
R29	" -102	"	1 K
R30	" -102	"	1 K
R31	" -103	"	10 K
R32	" -103	"	10 K
R33	" -103	"	10 K
R34	" -103	"	10 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R35	QRD181J-472	CR	4.7 K
R36	" -103	"	10 K
R37	" -103	"	10 K
R38	" -102	"	1 K
R39	" -103	"	10 K
R40	" -103	"	10 K
R41	" -103	"	10 K
R42	" -103	"	10 K
R43	" -103	"	10 K
R44	" -103	"	10 K
R45	" -103	"	10 K
R46	" -103	"	10 K
R47	" -103	"	10 K
R48	" -103	"	10 K
R49	" -103	"	10 K
R50	" -102	"	1 K
R51	" -102	"	1 K
R52	" -102	"	1 K
R53	" -102	"	1 K
R54	" -102	"	1 K
R55	" -103	"	10 K
R56	" -103	"	10 K
R57	" -103	"	10 K
R58	" -103	"	10 K
R59	" -103	"	10 K
R60	" -103	"	10 K
R61	" -222	"	2.2 K
R62	" -222	"	2.2 K
R63	" -103	"	10 K
R64	" -103	"	10 K
R65	" -333	"	33 K
R66	" -333	"	33 K
R67	" -103	"	10 K
R68	" -104	"	100 K
R69	" -103	"	10 K
R70	" -333	"	33 K
R71	" -105	"	1 M
R72	" -105	"	1 M
R73	" -103	"	10 K
R74	—	—	
R75	QRD181J-103	CR	10 K
R76	" -473	"	47 K
R77	" -333	"	33 K
R78	" -333	"	33 K
R79	" -333	"	33 K
R80	—	—	
R81	QRG019J-470S	OMR	47 1 W
R82	" -680S	"	68 "
R83	QRD122J-102	CR	1 K 1/2 W
R84	" -222	"	2.2 K "
R85	" -102	"	1 K "
R86	" -222	"	2.2 K "
R87	—	—	
R88	—	—	
R89	—	—	
R90	QRD181J-392	CR	3.9 K
R91	" -102	"	1 K
R92	" -104	"	100 K
R93	" -471	"	470
R94	—	—	
R95	QRD181J-103	CR	10 K
R96	" -334	"	330 K
R97	QRD182J-103	"	10 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C 1	QEK61CM-226	E Cap	22 16 V
C 2	" -226	"	22 "
C 3	QET61CM-226	"	22 "
C 4	QET61EM-476	"	47 25 V
C 5	QEK61HM-105	"	1 50 V
C 6	" -105	"	1 "
C 7	QET61HM-105	"	1 "
C 8	" -105	"	1 "
C 9	QFN31HK-472	MY Cap	0.0047 "
C10	" -103	"	0.01 "
C11	QET61CM-106	E Cap	10 16 V
C12	" -106	"	10 "
C13	" -106	"	10 "
C14	QFN31HK-103	MY Cap	0.01 50 V
C15	" -333	"	0.033 "
C16	" -333	"	0.033 "
C17	QCS31HJ-471	C Cap	470 P "
C18	" -121	"	120 P "
C19	" -331	"	330 P "
C20	" -101	"	100 P "
C21	" -101	"	100 P "
C22	QEK61CM-226	E Cap	22 16 V
C23	QEE41CM-106	T Cap	10 "
C24	QET61CM-476	E Cap	47 "
C25	" -336	"	33 "
C26	QCC51CN-223	C Cap	0.022 16 V
C27	PU54342	"	
IB 1	PU33106-016	Inline Block	
IB 2	" -015	"	
CF 1	PU50224	Ceramic Filter	
CF 2	PU49487	"	
	PU43351-9	Cap. Housing	1–9
	" -20	"	11–30
	" -7	"	31–37
	" -6	"	41–46
	" -7	"	51–57
	" -6	"	61–66
	" -12	"	71–82
	" -2	"	91–92
	PU51945-10	Housing	101–110
	" -20	"	111–130
	PU43351-7	Cap. Housing	141–147
	" -7	"	151–157
	PU51942	Shield Case (1)	
	PU51943	" (2)	for Top
	PU51944	" (3)	for Bottom
⚠	PU33328	Heat Sink	for Q14, Q15
	PU45373-3	Transistor Spacer	
	GPST3006ZS	Screw	
	SBST3006ZS	"	

8.2.13 Operation Board Ass'y $\boxed{1}\boxed{3}$ PU10434B

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	M50115AP	Integrated Circuit	
Q 1	2SD636Q,R	Transistor	2SD636R
D 1	1S2473	Diode	
D 2	HZ7B-2L	Zener Diode	
D 3	HZ6C-2L	"	
D 4	1S2473	Diode	
D 5	"	"	
D 6	"	"	
D 7	W03C	"	
D 8	"	"	
D 9	"	"	
D10	–	–	
D11	SLR34MT5	LED	
D12	GL3HD5	"	
D13	SLR34MT5	"	
D14	GL3HD5	"	
D15	"	"	
D16	"	"	
D17	"	"	
D18	"	"	
D19	"	"	
D20	"	"	
D21	"	"	
D22	"	"	
D23	"	"	
D24	"	"	
D25	"	"	
D26	"	"	
R 1	QRD181J-102	CR	1 K
R 2	" -102	"	1 K
R 3	" -333	"	33 K
R 4	" -154	"	150 K
R 5	" -821	"	820
R 6	" -821	"	820
R 7	" -821	"	820
R 8	" -821	"	820
R 9	" -821	"	820
R10	" -821	"	820
R11	" -821	"	820
R12	" -821	"	820
R13	" -821	"	820
R14	" -821	"	820
R15	" -821	"	820
R16	" -821	"	820
R17	" -821	"	820
R18	" -821	"	820
R19	" -821	"	820
R20	" -821	"	820
R21	–	–	
C 1	QET61HR-335	E Cap	3.3 50 V
C 2	QCS41HJ-221	C Cap	220 P "
C 3	" -221	"	220 P "

Symbol No.	Part No.	Part Name	Recommended Part/ Description
CF 1	PU49487-2	Ceramic Filter	
S 1	QSL2318-009	Lever Switch	Sub-power
S 2	PU51189	Tact Switch	
S 3	"	"	
S 4	"	"	
S 5	"	"	
S 6	"	"	
S 7	"	"	
S 8	"	"	
S 9	"	"	
S10	"	"	
S11	"	"	
S12	"	"	
S13	"	"	
	PU43351-120	Cap. Housing	1–20
	" -103	"	21–23
	" -102	"	31–32
	PU50634	LED Spacer (B)	for D12, D14–D26
	PU52427	"	for D11, 13

8.2.14 Servo Board Ass'y 1 4 .... PU10587A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	BA6305	Integrated Circuit	
IC 2	BA6302A	"	
IC 3	MB84066BM	"	
IC 4	UPC1458C	"	
⚠ IC 5	M54544L	"	
⚠ IC 6	UPD553C-237	"	
⚠ IC 7	BA851	"	
IC 8	UPC4558C	"	
IC 9	MB84066BM	"	
IC10	BA6302A	"	
IC11	–	–	
IC12	MB84066BM	Integrated Circuit	
IC13	MB3614	"	
⚠ IC14	HA13008	"	
IC15	UPC4558C	"	
IC16	BA222V	"	
IC17	UPC393C	"	
IC18	M54519P	"	
IC19	"	"	
Q 1	2SB641R,S	Transistor	2SB641S
Q 2	2SD636R,S	"	2SD636S
Q 3	"	"	"
Q 4	–	–	
Q 5	2SB641R,S	Transistor	2SB641S
Q 6	2SD636R,S	"	2SD636S
Q 7	"	"	"
Q 8	"	"	"
Q 9	"	"	"
Q10	"	"	"
Q11	2SB641R,S	"	2SB641S
Q12	"	"	"
D 1	1S2473 or MA150	Diode	1S2473
D 2	"	"	"
D 3	"	"	"
D 4	"	"	"
D 5	"	"	"
D 6	"	"	"
D 7	"	"	"
D 8	"	"	"
D 9	"	"	"
D10	HZ6A-1L	Zener Diode	
D11	HZ16-2L	"	
D12	1S2473 or MA150	Diode	1S2473
D13	"	"	"
D14	"	"	"
D15	–	–	
D16	MA150	Diode	1S2473
D17	"	"	"
D18	"	"	"
D19	"	"	"
D20	"	"	"
D21	"	"	"
D22	"	"	"
D23	"	"	"
D24	HZ5C-2	Zener Diode	
D25	1S2473 or MA150	Diode	1S2473
D26	"	"	"

Symbol No.	Part No.	Part Name	Recommended Part/ Description
D27	1S2473 or MA150TA	Diode	1S2473
D28	"	"	"
D29	"	"	"
D30	"	"	"
D31	"	"	"
D32	"	"	"
D33	"	"	"
D34	"	"	"
D35	"	"	"
D36	"	"	"
D37	"	"	"
D38	"	"	"
D39	"	"	"
D40	"	"	"
D41	"	"	"
D42	"	"	"
D43	"	"	"
D44	"	"	"
D45	"	"	"
D46	"	"	"
D47	"	"	"
D48	"	"	"
D49	"	"	"
D50	"	"	"
⚠ D51	RD20EB3	"	
⚠ D52	RD20EB3	"	or RD22FB1
D53	RD5.1EB1	"	or HZ5B-3
R 1	–	–	
R 2	QRD181J-272	CR	2.7 K
R 3	" -331	"	330
R 4	" -334	"	330 K
R 5	" -103	"	10 K
R 6	" -103	"	10 K
R 7	" -102	"	1 K
R 8	" -394	"	390 K
R 9	" -103	"	10 K
R10	" -103	"	10 K
R11	" -154	"	150 K
R12	QVZ3501-104	VR	100 K (N. CAP. DISCRI)
R13	QRV141F-6652	OMR	66.5 K
R14	QVZ3501-104	VR	100 K (P. CAP. DISCRI)
R15	QRV141F-1183	OMR	118 K
R16	QRD181J-104	CR	100 K
R17	" -564	"	560 K
R18	" -155	"	1.5 M
R19	" -473	"	47 K
R20	" -103	"	10 K
R21	" -102	"	1 K
R22	" -102	"	1 K
R23	" -103	"	10 K
R24	" -183	"	18 K
R25	" -824	"	820 K
R26	" -272	"	2.7 K
R27	" -183	"	18 K
R28	" -684	"	680 K
R29	" -473	"	47 K
R30	" -182	"	1.8 K
R31	" -103	"	10 K
R32	QVP4AOB-103	VR	10 K (N. SLOW P. LEV.)
R33	QRD181J-223	CR	22 K
R34	" -223	"	22 K
R35	QVP4AOB-154	VR	150 K (P. SLOW P. LEV.)
R36	QRD181J-563	CR	56 K
R37	" -273	"	27 K
R38	" -273	"	27 K
R39	" -124	"	120 K
R40	QVP4AOB-154	VR	150 K(PAL PRESET)
R41	QRD181J-563	CR	56 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R42	QVP4AOB-154	VR	150 K (N. PRE SET)
R43	QRD182J-683	CR	68 K
R44	PU51884	VR	250 K (X2/STD TRACKING)
R45	QRV141F-5112	OMR	51.1 K
R46	QRD181J-393	CR	39 K
R47	QRV141F-1963	OMR	196 K
R48	–	–	
R49	QRD181J-104	CR	100 K
R50	" -334	"	330 K
R51	" -334	"	330 K
R52	" -684	"	680 K
R53	" -332	"	3.3 K
R54	" -104	"	100 K
R55	" -103	"	10 K
R56	QVP4AOB-473	VR	47 K (D. PU. P. LEVEL)
R57	QRD181J-223	CR	22 K
R58	QVZ3501-224	VR	220 K (CH-2 SW)
R59	QRD181J-224	CR	220 K
R60	" -223	"	22 K
R61	QVZ3501-224	VR	220 K (CH-1 SW)
R62	QRD181J-224	CR	220 K
R63	" -273	"	27 K
R64	" -224	"	220 K
R65	QVP4A0B-104	VR	100 K (CH-2 V.P)
R66	QRD181J-153	CR	15 K
R67	" -153	"	15 K
R68	PU51885	VR	100 K (CH-1 V.P)
R69	QRD181J-153	CR	15 K
R70	" -153	"	15 K
R71	" -274	"	270 K
R72	" -104	"	100 K
R73	QVZ3501-224	VR	220 K (REC SW)
R74	QRD181J-683	CR	68 K
R75	" -225	"	2.2 M
R76	" -334	"	330 K
R77	" -103	"	10 K
R78	" -103	"	10 K
R79	" -563	"	56 K
R80	" -103	"	10 K
R81	" -103	"	10 K
R82	" -103	"	10 K
R83	" -333	"	33 K
R84	" -681	"	680
R85	" -123	"	12 K
R86	" -224	"	220 K
R87	" -563	"	56 K
R88	" -103	"	10 K
R89	–	–	
R90	–	–	
R91	QRD181J-103	CR	10 K
R92	" -224	"	220 K
R93	" -332	"	3.3 K
R94	" -333	"	33 K
R95	" -472	"	4.7 K
R96	" -474	"	470 K
R97	QRV143F-2552	OMR	25.5 K
R98	QRD181J-682	CR	6.8 K
R99	" -104	"	100 K
R100	QVZ3501-683	VR	68 K (P. D. DISCRI)
R101	QRV141F-1433	OMR	143 K
R102	QVZ3501-473	VR	47 K (N. D. DISCRI)
R103	QRD181J-225	CR	220 K
R104	" -103	"	10 K
R105	" -103	"	10 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R106	QRD181J-103	CR	10 K
R107	QVP4A0B-103	VR	10 K (H DISCRI)
R108	–	–	
R109	QRD181J-104	CR	100 K
R110	–	–	
R111	QRD181J-562	CR	5.6 K
R112	" -823	"	82 K
R113	" -102	"	1 K
R114	" -105	"	1 M
R115	" -683	"	68 K
R116	" -393	"	39 K
R117	" -393	"	39 K
R118	" -393	"	39 K
R119	" -184	"	180 K
R120	" -683	"	68 K
R121	" -152	"	1.5 K
R122	" -471	"	470
R123	" -103	"	10 K
R124	" -223	"	22 K
R125	" -181	"	180
R126	" -270	"	27
R127	QRX019J-R82S	MFR	0.82
R128	QRD181J-103	CR	10 K
R129	" -181	"	180
R130	" -270	"	27
R131	" -331	"	330
R132	" -331	"	330
R133	" -681	"	680
R134	" -104	"	100 K
R135	" -103	"	10 K
R136	QVP4A0B-224	VR	220 K (N. PRE SET)
R137	" -334	"	330 K (P. PRE SET)
R138	QRD181J-124	CR	120 K
R139	PU51884	VR	250 K (SLOW TRACKING)
R140	QRD181J-473	CR	47 K
R141	QVP4A0B-152	VR	1.5 K (FM. NOISE WIDTH)
R142	QRD181J-123	CR	12 K
R143	" -104	"	100 K
R144	" -225	"	2.2 M
R145	" -475	"	4.7 M
R146	" -333	"	33 K
R147	" -333	"	33 K
R148	" -103	"	10 K
R149	" -101	"	100
R150	PU51885	VR	100 K (SLOW SPEED)
R151	QRD181J-821	CR	820
R152	" -333	"	33 K
R153	" -823	"	82 K
R154	" -473	"	47 K
R155	" -102	"	1 K
R156	" -473	"	47 K
R157	" -473	"	47 K
R158	" -102	"	1 K
R159	" -103	"	10 K
R160	" -103	"	10 K
R161	" -103	"	10 K
R162	" -103	"	10 K
R163	" -473	"	47 K
R164	" -473	"	47 K
R165	" -473	"	47 K
R166	" -473	"	47 K
R167	" -104	"	100 K
R168	" -471	"	470

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R169	QRD181J-103	CR	10 K
R170	" -153	"	15 K
R171	" -103	"	10 K
R172	" -272	"	2.7 K
R173	" -103	"	10 K
R174	" -273	"	27 K
R175	" -333	"	33 K
R176	" -392	"	3.9 K
R177	" -392	"	3.9 K
R178	" -473	"	47 K
R179	" -154	"	150 K
R180	" -104	"	100 K
⚠ R181	PU52108-2R2K	Posistor	2.2 K
C 1	QET61CM-476	E Cap	47 16 V
C 2	" -226	"	22 "
C 3	" -476	"	47 "
C 4	QCY61HK-102	C Cap	0.001 50 V
C 5	QET61CM-106	E Cap	10 16 V
C 6	QCX11EM-153	C Cap	0.015 25 V
C 7	QET61CM-106	E Cap	10 16 V
C 8	QFN31HJ-104	MY Cap	0.1 50 V
C 9	QET61CM-226	E Cap	22 16 V
C10	QCY61HK-122	C Cap	0.0012 50 V
C11	QFN31HK-183	MY Cap	0.018 "
C12	" -103	"	0.01 "
C13	QFM71HJ-823	"	0.082 "
C14	–	–	
C15	–	–	
C16	QEB61CM-106	LL Cap	10 16 V
C17	" -106	"	10 "
C18	QEN61HM-106	NP Cap	10 50 V
C19	QET61HM-475	E Cap	4.7 "
C20	QEN61HM-475	NP Cap	4.7 "
C21	QET61VM-476	E Cap	47 "
C22	QET61CM-476	"	47 16 V
C23	QFM71HJ-124	MY Cap	0.12 50 V
C24	" -104	"	0.1 "
C25	" -124	"	0.12 "
C26	" -473	"	0.047 "
C27	QFN31HK-473	"	0.047 "
C28	QCY61HK-102	C Cap	0.001 "
C29	" -331	"	330 P "
C30	QFN31HK-124	MY Cap	0.12 "
C31	QCX11EM-153	C Cap	0.015 "
C32	QET61CM-106	E Cap	10 16 V
C33	QFM71HJ-822	MY Cap	0.0082 50 V
C34	" -822	"	0.0082 "
C35	" -222	"	0.0022 "
C36	QFN31HK-103	"	0.01 "
C37	" -103	"	0.01 "
C38	" -102	"	0.001 "
C39	QFM71HJ-473	"	0.047 "
C40	QFN31HK-393	"	0.039 "
C41	QCY61HK-331	C Cap	330 P "
C42	QFM71HJ-223	MY Cap	0.022 "
C43	QCV31HK-472	C Cap	0.0047 "
C44	QCY61HJ-471	"	470 P "
C45	QFN31HK-104	MY Cap	0.1 "
C46	" -123	"	0.012 "
C47	" -123	"	0.012 "
C48	QEN61CM-106	NP Cap	10 16 V
C49	QFN31HK-562	MY Cap	0.0056 50 V
C50	QET61CM-337	E Cap	330 16 V
C51	–	–	
C52	QET61CM-106	E Cap	10 16 V
C53	QFN31HK-333	MY Cap	0.033 50 V
C54	QET61CM-226	E Cap	22 16 V
C55	–	–	

Symbol No.	Part No.	Part Name	Recommended Part/ Description	
C56	QCX11EM-103	C Cap	0.01	25 V
C57	QFM71HJ-152	MY Cap	0.0015	50 V
C58	QFP42AJ-222	PP Cap	0.0022	100 V
C59	QFN31HK-102	MY Cap	0.001	50 V
C60	QCY61HJ-102	C Cap	0.001	″
C61	″ -102	″	0.001	″
C62	–	–		
C63	–	–		
C64	–	–		
C65	–	–		
C66	–	–		
C67	QEK51HM-106	E Cap	10	50 V
C68	″ -106	″	10	16 V
C69	QFN31HK-473	MY Cap	0.047	50 V
C70	″ -104	″	0.1	″
C71	″ -392	″	0.0039	″
C72	QCV11HK-222	C Cap	0.0022	″
C73	QEN61HM-475	NP Cap	4.7	″
C74	QET61HM-225	E Cap	2.2	″
C75	QEN61HM-475	NP Cap	4.7	″
C76	QFN31HK-103	MY Cap	0.01	″
C77	QET61CM-107	E Cap	100	16 V
C78	″ -336	″	33	″
C79	QFN61HM-474	MY Cap	0.47	50 V
C80	QET61CM-226	E Cap	22	16 V
C81	″ -106	″	10	″
C82	QET61HM-474	″	0.47	50 V
C83	QFN31HK-104	MY Cap	0.1	″
C84	QET60JM-476	E Cap	47	6.3 V
C85	QET61EM-475	″	4.5	25 V
C86	QCY61HK-102	C Cap	0.001	50 V
C87	QFN31HK-683	MY Cap	0.068	″
C88	QET61CM-106	E Cap	10	16 V
C89	QCY61HJ-102	C Cap	0.001	50 V
C90	QEK51HM-474	E Cap	0.47	″
C91	QET61HM-475	″	4.7	50 V
C92	QCS41HJ-121	C Cap	120 P	″
C93	QCY61HJ-331	″	330 P	″
C94	QEE51CM-106	T Cap		
C95	QFN31HK-473	MY Cap	0.047	50 V
C96	QEK51HM-474	E Cap	0.47	″
C97	″ -474	″	0.47	″
C98	QCF31HP-102	C Cap	0.001	″
C99	QCY61HK-102	″	0.001	″
C100	QCF31HP-102	″	0.001	″
C101	QFN31HK-393	MY Cap	0.039	″
C102	QCF31HP-102	C Cap	0.001	″
C103	QFN31HJ-334	MY Cap	0.33	″
C104	QEN61HM-105	NP Cap	1	″
C105	–	–		
C106	QFN31HK-124	MY Cap	0.12	50 V
C107	–	–		
C108	QET61CM-226	E Cap	22	16 V
C109	QCX11EM-103	C Cap	0.01	25 V
C110	QFN31HK-103	MY Cap	0.01	50 V
C111	″ -103	″	0.01	″
C112	″ -103	″	0.01	″
C113	″ -102	″	0.001	″
C114	QFN31HJ-393	MY Cap	0.039	50 V
C115	QET41HM-104	E Cap	0.1	″
C116	QET41HM-105	″	1	″
C117	″ -105	″	1	″
X 1	PU47701	Crystal		
	PU50224	Ceramic Filter		

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IB 1	PU33106-045	Inline Block	
IB 2	″ -046	″	
IB 3	″ -021	″	
IB 4	″ -047	″	
IB 5	″ -023	″	
	PU51945-10	Housing	1–10
	″ -20	″	11–30
	PU43351-7	Cap. Housing	31–37
	″ -2	″	41–42
	″ -2R	″	51–52
	″ -14	″	61–74
	″ -2Y	″	81–82
	″ -5	″	91–95
	″ -2	″	101–102
	″ -2	″	111–112
	″ -3	″	121–123
	″ -2	″	131–132
	″ -3	″	141–143
	″ -6	″	151–156
	″ -3	″	161–163
	″ -3	″	171–173(Test Point)
	″ -5	″	181–185(Test Point)
	″ -2	″	191–192(Test Point)
SW 1	QSL0012-001	System Select Switch	
SW 2	QSL0011-001	STD Switch	
SW 3	″ -001	DOLBY Switch	
SW 4	QSL0012-001	Counter Search Switch	
SW 5	PU52025	Insert Switch	
	PU52024	Mic Jack	
	PU52105	Plastic Rivet	
	PU48016-1	Mini Clamp	
	PU21450	CTL Box	
	PU33152	PWB Stay	
	E48729-001	Plastic Rivet	
	SSSP2604Z	Screw	

8.2.15 Y & Pre/Rec Board Ass'y 1 5 . . . . PU10586A1

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC101	BA7001	Integrated Circuit	
IC102	MB84066BM	"	
IC103	AN607P	"	
IC104	BA7001	"	
IC105	–	–	
IC106	HA11738	Integrated Circuit	
⚠ IC107	HA11724	"	
IC108	3VT02	"	
IC109	10VT11	"	
IC110	BX6010	"	
IC111	BX6011	"	
IC112	–	–	
IC113	BX6013	Integrated Circuit	
IC114	BX6014	"	
Q101	2SC2021Q,R,S	Transistor	2SC2021S
Q102	–	–	
Q103	2SC2021Q	Transistor	
Q104	2SC2021Q,R,S	"	2SC2021S
Q105	–	–	
Q106	–	–	
Q107	2SC2021Q	Transistor	
Q108	"	"	
Q109	"	"	
Q110	2SC2021Q,R,S	"	2SC2021S
Q111	–	–	
Q112	–	–	
Q113	–	–	
Q114	–	–	
Q115	–	–	
Q116	2SC2021Q,R,S	Transistor	2SC2021S
Q117	–	–	
Q118	–	–	
Q119	–	–	
Q120	2SC2021Q,R,S	Transistor	2SC2021S
Q121	"	"	"
Q122	"	"	"
Q123	–	–	
Q124	2SC2021Q,R,S	Transistor	2SC2021S
Q125	"	"	"
Q126	"	"	"
Q127	"	"	"
Q128	"	"	"
Q129	"	"	"
Q130	"	"	"
Q131	"	"	"
Q132	–	–	
Q133	–	–	
Q134	–	–	
Q135	2SC2021Q,R,S	Transistor	2SC2021S
Q136	"	"	"
Q137	"	"	"
Q138	2SB641Q	"	
Q139	2SC2021Q,R,S	"	2SC2021S
Q140	2SA874R	"	
Q141	2SC1652R	"	
D101	MA27TB-TA	Diode	MA27TB
D102	1SS133	"	
D103	"	"	
D104	"	"	
D105	"	"	
D106	"	"	
R101	QVZ3244-222	VR	2.2 K (PB CCIR Y)
R102	QRD161J-102	CR	1 K
R103	–	–	
R104	–	–	
R105	QVZ3244-102	VR	1 K (PB NTSC Y)
R106	QRD161J-561	CR	560
R107	–	–	
R108	QRD161J-103	CR	10 K
R109	–	–	
R110	–	–	
R111	–	–	
R112	–	–	
R113	–	–	
R114	–	–	
R115	QRD161J-122	CR	1.2 K
R116	" -102	"	1 K
R117	–	–	
R118	–	–	
R119	–	–	
R120	QRD161J-152	CR	1.5 K
R121	–	–	
R122	–	–	
R123	QRD161J-681	CR	680
R124	" -391	"	390
R125	" -391	"	390
R126	" -681	"	680
R127	" -271	"	270
R128	" -271	"	270
R129	" -102	"	1 K
R130	" -121	"	120
R131	" -121	"	120
R132	" -223	"	22 K
R133	" -103	"	10 K
R134	" -102	"	1 K
R135	" -122	"	1.2 K
R136	" -102	"	1 K
R137	" -222	"	2.2 K
R138	" -121	"	120
R139	" -682	"	6.8 K
R140	" -391	"	390
R141	" -102	"	1 K
R142	" -221	"	220
R143	" -102	"	1 K
R144	" -102	"	1 K
R145	–	–	
R146	–	–	
R147	QRD161J-102	CR	1 K
R148	–	–	
R149	–	–	
R150	QRD161J-561	CR	560
R151	" -122	"	1.2 K
R152	" -331	"	330
R153	QVZ3244-681	VR	680 (CCIR RF EQ)
R154	QRD161J-681	CR	680
R155	–	–	
R156	–	–	
R157	QRD161J-561	CR	560
R158	" -102	"	1 K
R159	" -102	"	1 K
R160	–	–	
R161	–	–	
R162	–	–	
R163	–	–	
R164	–	–	
R165	–	–	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R166	–	–	
R167	–	–	
R168	–	–	
R169	–	–	
R170	QRD161J-222	CR	2.2 K
R171	″ -222	″	2.2 K
R172	–	–	
R173	–	–	
R174	–	–	
R175	–	–	
R176	–	–	
R177	–	–	
R178	–	–	
R179	–	–	
R180	–	–	
R181	–	–	
R182	–	–	
R183	–	–	
R184	–	–	
R185	–	–	
R186	QRD161J-104	CR	100 K
R187	″ -223	″	22 K
R188	″ -103	″	10 K
R189	QVZ3244-471	VR	470 (EE LEVEL)
R190	QRD161J-221	CR	220
R191	–	–	
R192	QRD161J-102	CR	1 K
R193	–	–	
R194	QRD161J-183	CR	18 K
R195	″ -473	″	47 K
R196	–	–	
R197	–	–	
R198	QRD161J-224	CR	220 K
R199	″ -222	″	2.2 K
R200	″ -394	″	390 K
R201	QVZ3244-472	VR	4.7 K (NTSC DEV.)
R202	QRD161J-682	CR	6.8 K
R203	QVZ3244-152	VR	1.5 K (CCIR DEV.)
R204	QRD161J-102	CR	1 K
R205	″ -103	″	10 K
R206	″ -272	″	2.7 K
R207	″ -223	″	22 K
R208	″ -562	″	5.6 K
R209	″ -122	″	1.2 K
R210	–	–	
R211	–	–	
R212	–	–	
R213	–	–	
R214	–	–	
R215	QRD161J-822	CR	8.2 K
R216	QVZ3244-152	VR	1.5 K (WHITE CLIP)
R217	QRD161J-331	CR	330
R218	″ -222	″	2.2 K
R219	QVZ3244-152	VR	1.5 K (DARK CLIP)
R220	QRD161J-562	CR	5.6 K
R221	–	–	
R222	QRD161J-563	CR	56 K
R223	″ -103	″	10 K
R224	″ -223	″	22 K
R225	″ -562	″	5.6 K
R226	″ -682	″	6.8 K
R227	″ -682	″	6.8 K
R228	″ -123	″	12 K
R229	″ -681	″	680
R230	″ -332	″	3.3 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R231	PU54155-103	VR	10 K (CH-1 Q)
R232	″ -103	″	10 K (CH-2 Q)
R233	QRD161J-681	CR	680
R234	″ -391	″	390
R235	″ -471	″	470
R236	–	–	
R237	QRD161J-182	CR	1.8 K
R238	–	–	
R239	–	–	
R240	QRD161J-102	CR	1 K
R241	″ -682	″	6.8 K
R242	″ -562	″	5.6 K
R243	″ -102	″	1 K
R244	″ -223	″	22 K
R245	″ -223	″	22 K
R246	″ -223	″	22 K
R247	″ -682	″	6.8 K
R248	″ -101	″	100
R249	QVZ3244-681	VR	680 (NTSC REC FM)
R250	QRD161J-101	CR	100
R251	QVZ3244-222	VR	2.2 K (CCIR REC FM)
R252	–	–	
R253	QRD161J-222	CR	2.2 K
R254	″ -471	″	470
R255	″ -222	″	2.2 K
R256	″ -103	″	10 K
R257	″ -103	″	10 K
R258	″ -223	″	22 K
R259	″ -223	″	22 K
R260	″ -682	″	6.8 K
R261	″ -682	″	6.8 K
R262	″ -332	″	3.3 K
R263	″ -104	″	100 K
R264	″ -222	″	2.2 K
R265	″ -101	″	100
R266	–	–	
R267	QRD161J-331	CR	330
R268	–	–	
R269	–	–	
R270	–	–	
R271	–	–	
R272	QRD161J-332	CR	3.3 K
R273	″ -564	″	560 K
R274	–	–	
R275	–	–	
R276	QRD161J-222	CR	2.2 K
R277	″ -103	″	10 K
R278	″ -223	″	22 K
R279	″ -103	″	10 K
R280	″ -153	″	15 K
R281	″ -223	″	22 K
R282	″ -103	″	10 K
R283	–	–	
R284	–	–	
R285	–	–	
R286	QRD161J-271	CR	270
R287	–	–	
R288	QRD161J-333	CR	33 K
R289	ERT-D2FHL-332S	Thermistor	3.3 K
R290	QRD161J-103	CR	10 K
R291	QVZ3244-152	VR	1.5 K (NTSC CARR.)
R292	QRD161J-681	CR	680
R293	QVZ3244-222	VR	2.2 K (CCIR CARR.)
R294	QRD161J-223	CR	22 K
R295	″ -103	″	10 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R296	QRD161J-103	CR	10 K
R297	" -471	"	470
R298	" -223	"	22 K
R299	" -223	"	22 K
R300	" -103	"	10 K
R301	" -681	"	680
R302	" -681	"	680
R303	" -330	"	33
R304	" -330	"	33
R305	" -220	"	22
R306	" -220	"	22
R307	" -102	"	1 K
R308	" -332	"	3.3 K
R309	" -332	"	3.3 K
R310	" -102	"	1 K
R311	" -561	"	560
R312	" -275	"	2.7 M
R313	" -221	"	220
R314	" -223	"	22 K
R315	" -103	"	10 K
R316	" -223	"	22 K
R317	" -104	"	100 K
R318	" -332	"	3.3 K
R319	" -682	"	6.8 K
C101	QET61CR-106	E Cap	10 16 V
C102	QET61AR-476	"	47 10 V
C103	" -476	"	47 "
C104	QCF31HP-223	C Cap	0.022 50 V
C105	QET61AR-476	E Cap	47 10 V
C106	QCF31HP-223	C Cap	0.022 50 V
C107	QET61AR-476	E Cap	47 10 V
C108	QCS31HJ-270	C Cap	27 P 50 V
C109	QET61AR-476	E Cap	47 10 V
C110	" -476	"	47 "
C111	QCF11HP-223	C Cap	0.022 50 V
C112	–	–	
C113	QCF31HP-223	C Cap	0.022 50 V
C114	QET61AR-476	E Cap	47 10 V
C115	PU51163-151	C Cap	150 P
C116	" -201	"	200 P
C117	–	–	
C118	–	–	
C119	–	–	
C120	QET61AR-476	E Cap	47 10 V
C121	" -476	"	47 "
C122	QCS31HJ-680	C Cap	68 P 50 V
C123	" -680	"	68 P "
C124	QCF31HP-223	"	0.022 "
C125	QCS31HJ-390	"	39 P "
C126	" -471	"	470 P "
C127	QET61AR-476	E Cap	47 10 V
C128	" -476	"	47 "
C129	" -476	"	47 "
C130	QCF31HP-223	C Cap	0.022 50 V
C131	" -223	"	0.022 "
C132	" -103	"	0.01 "
C133	" -103	"	0.01 "
C134	" -103	"	0.01 "
C135	" -223	"	0.022 "
C136	QCS31HJ-560	"	56 P "
C137	" -220	"	22 P "
C138	" -180	"	18 P "
C139	" -560	"	56 P "
C140	–	–	
C141	–	–	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C142	–	–	
C143	–	–	
C144	–	–	
C145	QET61AR-476	E Cap	47 10 V
C146	–	–	
C147	QET61AR-476	E Cap	47 10 V
C148	–	–	
C149	–	–	
C150	–	–	
C151	–	–	
C152	–	–	
C153	QFN31HJ-563	MY Cap	0.056 50 V
C154	–	–	
C155	–	–	
C156	–	–	
C157	–	–	
C158	–	–	
C159	–	–	
C160	QCF31HP-223	C Cap	0.022 50 V
C161	–	–	
C162	–	–	
C163	–	–	
C164	–	–	
C165	QET60JR-476	E Cap	47 6.3 V
C166	QET61ER-475	"	4.7 25 V
C167	QET61AR-476	"	47 10 V
C168	QCF31HP-103	C Cap	0.01 50 V
C169	QCS31HJ-560	"	56 P "
C170	QET61AR-227	E Cap	220 10 V
C171	QCF31HP-223	C Cap	0.022 50 V
C172	QCS31HJ-560	"	56 P "
C173	QET60JR-227	E Cap	220 6.3 V
C174	QCT25CH-820	C Cap	82 P
C175	QCF31HP-223	"	0.022 50 V
C176	QFN31HJ-682	MY Cap	0.0068 "
C177	QCF31HP-223	C Cap	0.022 "
C178	QET61CR-226	E Cap	22 16 V
C179	QET61HR-105	"	1 50 V
C180	QCF31HP-223	C Cap	0.022 "
C181	QFN31HJ-104	MY Cap	0.1 "
C182	QCS31HJ-151	C Cap	150 P "
C183	QET61HR-225	E Cap	2.2 "
C184	QET61AR-107	"	100 10 V
C185	QCS31HJ-680	C Cap	68 P 50 V
C186	" -330	"	33 P "
C187	QCF31HP-223	"	0.022 "
C188	QCS31HJ-5R0	"	5 P "
C189	QCF31HP-223	"	0.022 "
C190	QCS31HJ-100	"	10 P "
C191	QET61AR-476	E Cap	47 10 V
C192	QET61ER-475	"	4.7 25 V
C193	QCT25CH-121	C Cap	120 P
C194	QCS31HJ-180	"	18 P 50 V
C195	QCF31HP-223	"	0.022 "
C196	QCS31HJ-120	"	12 P "
C197	QCF31HP-223	"	0.022 "
C198	QCS31HJ-151	"	150 P "
C199	QCF31HP-223	"	0.022 "
C200	QAT3001-036	TR Cap	60 P (CH-1 RESO)
C201	QCF31HP-103	C Cap	0.01 50 V
C202	QAT3001-036	TR Cap	60 P (CH-2 RESO)
C203	QFN31HJ-103	MY Cap	0.01 50 V
C204	QCF31HP-223	C Cap	0.022 "
C205	QET61HR-474	E Cap	0.47 "
C206	QCF31HP-223	C Cap	0.022 "

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C207	QCS31HJ-151	C Cap	150 P 50 V
C208	QET61AR-476	E Cap	47 10 V
C209	QCF31HP-223	C Cap	0.022 50 V
C210	QCS31HJ-221	"	220 P "
C211	" -560	"	56 P "
C212	QCS11HJ-150	"	15 P "
C213	QCF31HP-103	C Cap	0.01 50 V
C214	QCS31HJ-121	"	120 P "
C215	" -121	"	120 P "
C216	QCF31HP-103	"	0.01 "
C217	" -103	"	0.01 "
C218	" -103	"	0.01 "
C219	" -223	"	0.022 "
C220	" -223	"	0.022 "
C221	QET61AR-476	E Cap	47 10 V
C222	QET61ER-335	"	3.3 25 V
C223	QET60JR-336	"	33 6.3 V
C224	QCS31HJ-330	C Cap	33 P 50 V
C225	" -121	"	120 P "
C226	QCF31HP-103	"	0.01 "
C227	PU51163-301	"	300 P
C228	QET61AR-476	E Cap	47 10 V
C229	PU51163-331	C Cap	330 P
C230	" -511	"	510 P
C231	QET61AR-476	E Cap	47 10 V
C232	QET61CR-106	"	10 16 V
C233	" -106	"	10 "
C234	QFN31HJ-333	MY Cap	0.033 50 V
C235	" -333	"	0.033 "
C236	QET61AR-476	E Cap	47 10 V
C237	QCF31HP-223	C Cap	0.022 50 V
C238	QET61AR-476	E Cap	47 10 V
C239	QET61AR-476	"	47 10 V
C240	–	–	
C241	–	–	
C242	PU51163-471	C Cap	470 P
C243	–	–	
C244	QCF31HP-103	C Cap	0.01 50 V
C245	QCS31HJ-270	"	27 P "
C246	" -270	"	27 P "
⚠ L101	PU48530-101K	Coil	100 μH
⚠ L102	" -101K	"	100 μH
L103	–	–	
⚠ L104	PU48530-101K	Coil	100 μH
L105	–	–	
L106	–	–	
L107	PU48530-180J	Coil	18 μH
L108	" -180J	"	18 μH
L109	" -220J	"	22 μH
⚠ L110	" -101K	"	100 μH
L111	" -180J	"	18 μH
L112	" -180J	"	18 μH
L113	" -150J	"	15 μH
L114	" -330J	"	33 μH
L115	" -150J	"	15 μH
⚠ L116	" -101K	"	100 μH
L117	" -220J	"	22 μH
⚠ L118	" -101K	"	100 μH
⚠ L119	" -101K	"	100 μH
L120	–	–	
L121	–	–	
L122	–	–	
L123	–	–	
L124	–	–	
L125	–	–	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
L126	–	–	
L127	–	–	
L128	PU48530-330J	Coil	33 μH
⚠ L129	" -101K	"	100 μH
L130	" -331J	"	330 μH
L131	" -330J	"	33 μH
L132	" -390J	"	39 μH
L133	" -6R8J	"	6.8 μH
L134	" -560J	"	5.6 μ H
L135	" -221J	"	220 μ H
⚠ L136	" -101K	"	100 μH
⚠ L137	" -101K	"	100 μH
⚠ L138	" -101K	"	100 μH
L139	–	–	
L140	–	–	
⚠ L141	PU48530-101K	Coil	100 μH
⚠ L142	" -101 K	"	100 μH
DL101	PU53331-2	1H Delay Line	
LPF101	PU53474	Low-Pass Filter	
LPF102	PU53348	"	
LPF103	PU52644	"	
LPF104	PU52169	"	
EQ101	PU53475	Equalizer	
EQ102	PU53349	"	
EQ103	PU52649	"	
EQ104	PU51927-2	"	
EQ105	" -2	"	
	PU54074	Shield (1)	for Pre Amp
	PU54075	" (2)	for "
	PU54076	" (3)	for "
IB101	PU33106-048	Inline Block	
IB102	" -049	"	
IB103	" -050	"	
IB104	" -051	"	
	PU43351-2	Cap. Housing	(11–12)
	" -4	"	(21–24)
	" -7	"	(81–87)
	" -5	"	(91–95)
	" -3	"	(121–123)
	" -2R	"	(141–142)
	" -2		(151–152)
	PU50766	Test Pin	TP-GND, 103, 106 111

8.2.16 Fuse Board $\boxed{1}\boxed{6}$

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠	PU51936	Circuit Board	
⚠ C 1	QFE52EM-223M	MM Cap	0.022 250 V
⚠	PU51212	Fuse Clip	for F1
⚠	A74316	Tab	
⚠	PU43192-4	Binder	
F 1	–	Fuse (T1.25 A)	See Section 7.2.3.

8.2.17 Audio Board Ass'y $\boxed{1}\boxed{8}$ PU21467A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	UPD4066C	Integrated Circuit	
IC 2	HA12005	″	
IC 3	TA7629P	″	
IC 4	NJM4560D	″	
IC 5	BA222	″	
Q 1	2SD636R,S	Transistor	2SD636S
Q 2	2SB641R,S	″	2SB641S
Q 3	2SD636R,S	″	2SD636S
Q 4	2SD661S	″	
Q 5	2SD636R,S	″	2SD636S
Q 6	2SB788T,U,S	″	2SB788U
Q 7	2SD636R,S	″	2SD636S
Q 8	2SD958T,U,S	″	2SD958U
Q 9	″	″	″
Q10	2SD636R,S	″	2SD636S
Q11	″	″	″
Q12	″	″	″
Q13	2SB644R,S	″	2SB644S
Q14	″	″	″
Q15	2SD639R,S	″	2SD639S
⚠ Q16	2SA1020O,Y	″	2SA1020Y
⚠ Q17	2SD639S	″	
⚠ Q18	″	″	
Q19	2SB641R,S	″	2SB641S
Q20	2SD636R,S	″	2SD636S
Q21	″	″	″
Q22	″	″	″
Q23	″	″	″
Q24	″	″	″
D 1	MA150	Diode	
D 2	″	″	
D 3	″	″	
D 4	RD6.8EB2	Zener Diode	
D 5	″	″	
D 6	10E2FA-8	Diode	
D 7	MA150	″	
D 8	″	″	
D 9	HZ15-3	Zener Diode	
D10	RD3.9EB2	″	
D11	MA150	Diode	
D12	″	″	
D13	″	″	
D14	10E2FA-8	″	
R 1	QRD181J-103	CR	10 K
R 2	″ -224	″	220 K
R 3	″ -103	″	10 K
R 4	″ -224	″	220 K
R 5	″ -103	″	10 K
R 6	″ -224	″	220 K
R 7	″ -224	″	220 K
R 8	″ -224	″	220 K
R 9	″ -222	″	2.2 K
R10	″ -101	″	100
R11	″ -224	″	220 K
R12	QRD182J-333	″	33 K
R13	QRD181J-102	″	1 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R14	QRD181J-122	CR	1.2 K
R15	″ -122	″	1.2 K
R16	″ -102	″	1 K
R17	″ -103	″	10 K
R18	″ -103	″	10 K
R19	″ -334	″	330 K
R20	″ -334	″	330 K
R21	″ -334	″	330 K
R22	″ -334	″	330 K
R23	″ -334	″	330 K
R24	″ -222	″	2.2 K
R25	″ -822	″	8.2 K
⚠ R26	QRZ0054-330	FR	33 1/4 W
R27	QRD181J-682	CR	6.8 K
R28	″ -332	″	3.3 K
R29	″ -332	″	3.3 K
R30	″ -104	″	100 K
R31	QRD182J-563	″	56 K
R32	QRD181J-183	″	18 K
R33	″ -223	″	22 K
R34	″ -682	″	6.8 K
R35	″ -103	″	10 K
R36	″ -682	″	6.8 K
R37	″ -104	″	100 K
R38	″ -153	″	15 K
R39	″ -153	″	15 K
R40	″ -121	″	120
R41	″ -682	″	6.8 K
R42	″ -222	″	2.2 K
R43	″ -472	″	4.7 K
R44	″ -153	″	15 K
R45	″ -103	″	10 K
R46	″ -272	″	2.7 K
R47	″ -103	″	10 K
R48	″ -473	″	47 K
R49	″ -564	″	560 K
R50	″ -564	″	560 K
R51	″ -273	″	27 K
R52	″ -473	″	47 K
R53	″ -102	″	1 K
R54	QRD122J-331	″	330 1/2 W
R55	QRD181J-473	″	47 K
R56	″ -103	″	10 K
R57	″ -332	″	3.3 K
R58	″ -103	″	10 K
R59	″ -472	″	4.7 K
R60	″ -222	″	2.2 K
R61	″ -223	″	22 K
R62	″ -473	″	47 K
R63	″ -103	″	10 K
R64	″ -154	″	150 K
R65	″ -124	″	120 K
R66	″ -392	″	3.9 K
R67	″ -471	″	470
R68	″ -103	″	10 K
R69	″ -102	″	1 K
R70	QVZ3244-472	VR	4.7 K(PLAY LEVEL)
R71	QRD181J-473	CR	47 K
R72	″ -103	″	10 K
R73	″ -222	″	2.2 K
R74	″ -102	″	1 K
R75	″ -104	″	100 K
R76	″ -181	″	180
R77	″ -332	″	3.3 K
R78	″ -154	″	150 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R79	QRD181J-473	CR	47 K
R80	" -273	"	27 K
R81	" -274	"	270 K
R82	" -682	"	6.8 K
R83	" -154	"	150 K
R84	" -561	"	560
R85	" -103	"	10 K
R86	" -103	"	10 K
R87	QRD182J-104	"	100 K
R88	QRD181J-104	"	100 K
R89	" -103	"	10 K
R90	" -103	"	10 K
R91	–	–	
R92	–	–	
R93	QVZ3244-103	VR	10 K (C. REC LEV.)
R94	–	–	
R95	QVZ3244-223	VR	22 K (C. REC EQ)
R96	QRD181J-682	CR	6.8 K
R97	" -103	"	10 K
R98	" -153	"	15 K
R99	" -682	"	6.8 K
R100	" -221	"	220
R101	" -222	"	2.2 K
R102	–	–	
R103	QRD181J-103	CR	10 K
R104	" -223	"	22 K
R105	" -223	"	22 K
R106	" -472	"	4.7 K
R107	" -472	"	4.7 K
R108	" -103	"	10 K
R109	" -472	"	4.7 K
R110	" -821	"	820
R111	" -274	"	270 K
R112	" -103	"	10 K
R113	" -152	"	1.5 K
R114	" -821	"	820
⚠ R115	QRG029J-680	OMR	68 2 W
⚠ R116	" -560	"	56 "
R117	QRD181J-103	CR	10 K
R118	" -102	"	1 K
R119	" -103	"	10 K
R120	" -222	"	2.2 K
R121	" -102	"	1 K
R122	" -102	"	1 K
⚠ R123	QRZ0054-150	FR	15 1/4 W
⚠ R124	" -150	"	15 "
R125	QVZ3244-474	VR	470 K (REC BIAS)
R126	QRD181J-222	CR	2.2 K
R127	" -224	"	220 K
R128	" -103	"	10 K
R129	–	–	
R130	–	–	
R131	–	–	
R132	–	–	
R133	–	–	
R134	–	–	
R135	–	–	
R136	–	–	
R137	–	–	
R138	–	–	
R139	QRD181J-334	CR	330 K
R140	" -153	"	15 K
R141	" -271	"	270
R142	–	–	
R143	–	–	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R144	–	–	
R145	–	–	
R146	–	–	
R147	–	–	
R148	–	–	
R149	–	–	
R150	QRD181J-822	CR	8.2 K
R151	" -473	"	47 K
R152	" -473	"	47 K
R153	" -473	"	47 K
R154	" -473	"	47 K
R155	" -103	"	10 K
R156	" -473	"	47 K
R157	" -473	"	47 K
R158	" -473	"	47 K
R159	" -473	"	47 K
R160	QVZ3244-223	VR	22 K (N. REC EQ)
R161	QRD181J-473	CR	47 K
R162	" -473	"	47 K
R163	QVZ3244-683	VR	68 K (N. REC LEV.)
C 1	QET61CR-106	E Cap	10 16 V
C 2	" -106	"	10 "
C 3	" -106	"	10 "
C 4	" -106	"	10 "
C 5	" -106	"	10 "
C 6	" -106	"	10 "
C 7	" -106	"	10 "
C 8	" -106	"	10 "
C 9	QCY61HK-561	C Cap	560 P 50 V
C10	QET61ER-475	E Cap	4.7 25 V
C11	QET61CM-337	"	330 16 V
C12	QET60JR-107	"	100 6.3 V
C13	QET61ER-475	"	4.7 25 V
C14	QCY61HK-331	C Cap	330 P 50 V
C15	QET61CR-106	E Cap	10 16 V
C16	QFN31HK-102	MY Cap	0.001 50 V
C17	" -102	"	0.001 "
C18	QCY61HK-102	C Cap	0.001 "
C19	QET61CR-106	E Cap	10 16 V
C20	" -106	"	10 "
C21	QCX11EM-103	C Cap	0.01 25 V
C22	QET61CR-476	E Cap	47 16 V
C23	QET61HR-474	"	0.47 50 V
C24	QET61CR-107	"	100 16 V
C25	QCY61HJ-471	C Cap	470 P 50 V
C26	QEB41EM-475	E Cap	4.7 25 V
C27	QFN31HK-102	MY Cap	0.001 50 V
C28	" -273	"	0.027 "
C29	QET61CR-336	E Cap	33 16 V
C30	QCS41HK-101	C Cap	100 P 50 V
C31	QET61CR-106	E Cap	10 16 V
C32	QFN31HK-104	MY Cap	0.1 50 V
C33	QCS41HK-101	C Cap	100 P "
C34	QET61AR-227	E Cap	220 10 V
C35	QET61CR-106	"	10 16 V
C36	QFN31HK-562	MY Cap	0.0056 50 V
C37	" -273	"	0.027 "
C38	QCV31HK-472	C Cap	0.0047 "
C39	QFN31HK-473	MY Cap	0.047 "
C40	QET61CR-106	E Cap	10 16 V
C41	QEB41HM-104	"	0.1 50 V* (L.L.)
C42	" -334	"	0.33 50 V* (L.L.)

* L.L. : Low Leakage

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C43	QET61HM-105	E Cap	1 50 V
C44	QET61ER-475	"	4.7 25 V
C45	QCY61HK-181	C Cap	180 P 50 V
C46	QET61CR-106	E Cap	10 16 V
C47	QET61EM-475	"	4.7 25 V
C48	–	–	
C49	QCX31EM-103	C Cap	0.01 25 V
C50	QET61CR-106	E Cap	10 16 V
C51	QET61ER-475	"	4.7 25 V
C52	QFN31HK-103	MY Cap	0.01 50 V
C53	QET61ER-475	E Cap	4.7 25 V
C54	QET61CR-106	"	10 16 V
C55	QFN31HK-103	MY Cap	0.01 50 V
C56	QET61HR-105	E Cap	1 "
C57	" -106	"	10 "
C58	QFN31HK-104	MY Cap	0.1 "
C59	QET61HR-476	E Cap	47 "
C60	–	–	
C61	QET61CR-476	E Cap	47 16 V
C62	QCX11EM-103	C Cap	0.01 25 V
C63	" -103	"	0.01 "
C64	" -153	"	0.015 "
C65	QFP32XK-682	PP Cap	0.0068 600 V
C66	QCY61HK-561	C Cap	560 P 50 V
C67	QET61CR-107	E Cap	100 16 V
C68	QFN31HK-393	MY Cap	0.039 50 V
C69	QET41CM-477	E Cap	470 16 V
C70	–	–	
C71	QCY61HK-271	C Cap	270 P 50 V
C72	–	–	
C73	–	–	
C74	–	–	
C75	–	–	
C76	–	–	
C77	–	–	
C78	–	–	
C79	–	–	
C80	QCS31HJ-331	C Cap	330 P 50 V
C81	QFN31HJ-472	MY Cap	0.0047 "
C82	" -682	"	0.0068 "
L 1	PU51764	LPF	15.625 kHz Trap
L 2	PU47051-103	Coil	10 mH
⚠ L 3	PU49994-471	"	470 μH
L 4	" -181	"	180 μH
L 5	T40442-001	"	18 mH
T 1	PU30961	OSC Transformer	
RY 1	PU46682	Relay	
	PU43351-2	Cap. Housing	11–12
	" -4	"	21–24
	" -2R	"	31–32
	" -4Y	"	41–44
	" -2	"	51–52
	" -3Y	"	61–63
	" -3R	"	71–73
	" -3	"	81–83
	" -6	"	91–96
	" -4	"	101–104
	" -3	"	111–113
	PU43351-3	Cap. Housing	121–123
	PU52724	Shield Case	for L1
	PU43192-4	Binder	

8.2.18 Power Transistor Board 19

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51930	Circuit Board	
⚠ Q 2	2SC2484P	Transistor	
⚠ Q 6	2SC2484P	Transistor	
	PU41624-6	Isolation Washer	for Q2, Q6
	PU45375-4	Transistor Spacer	"
	SBST3008ZS	Screw	"

8.2.19 Supply Reel FG Board 20

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51604	Circuit Board	
PI-01	GP1L02 or PS4009	Photo Interrupter	GP1L02

8.2.20 Take-up Reel FG Board 21

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51604	Circuit Board	
PI-02	GP1L02 or PS4009	Photo Interrupter	GP1L02

8.2.21 Cue Head Board 22

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU33246A	Circuit Board	

8.2.22 Capstan FG Board 23

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU33253-2	Circuit Board	

8.2.23 Video Control Board Ass'y 2 4 . . PU21438A-M

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ IC 1	LM6416E-135	Integrated Circuit	
IC 2	LC4001B	"	
IC 3	UPD4066BC	"	
⚠ IC 4	BA7004	"	
IC 5	LA6458S	"	
⚠ Q 1	2SD1128-02	Transistor	
⚠ Q 2	2SB641S	"	
⚠ Q 3	"	"	
⚠ Q 4	"	"	
Q 5	2SD637R,S	"	2SD637S
Q 6	2SC2021Q,R,S	"	2SC2021S
Q 7	"	"	"
Q 8	2SC2021Q	"	
Q 9	2SD638Q,R	"	2SD638R
Q10	2SC2021Q,R,S	"	2SC2021S
Q11	"	"	"
Q12	"	"	"
Q13	"	"	"
Q14	"	"	"
Q15	2SB643R,S	"	2SB643S
⚠ Q16	2SB641S	"	
⚠ Q17	2SB641Q	"	
⚠ Q18	2SB641S	"	
Q19	2SC2021Q,R,S	"	2SC2021S
Q20	2SD638R,S	"	2SD638S
Q21	2SC2021Q,R,S	"	2SC2021S
D 1	HZ9A1	Zener Diode	
D 2	RD3.3EB1	"	
D 3	"	"	
D 4	1S2473HV	Diode	
D 5	"	"	
D 6	MA27TA	"	
D 7	1SS133	"	
D 8	"	"	
D 9	"	"	
D10	"	"	
D11	"	"	
D12	"	"	
D13	"	"	
D14	"	"	
D15	"	"	
D16	"	"	
D17	"	"	
D18	"	"	
D19	"	"	
D20	"	"	
D21	"	"	
D22	"	"	
D23	RD2.7EB1	Zener Diode	
D24	"	"	
D25	1SS133	Diode	
D26	RD6.8EBUB3	Zener Diode	
RA 1	EXB-P84103M	Resistor Array	10 K x 4
RA 2	"	"	"

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R 1	QRD161J-331	CR	330
R 2	" -103	"	10 K
R 3	" -103	"	10 K
R 4	" -103	"	10 K
R 5	" -472	"	4.7 K
R 6	" -222	"	2.2 K
⚠ R 7	" -152	"	1.5 K
R 8	" -104	"	100 K
R 9	" -473	"	47 K
R10	" -473	"	47 K
R11	" -223	"	22 K
R12	" -223	"	22 K
R13	" -333	"	33 K
R14	" -333	"	33 K
R15	" -333	"	33 K
R16	" -333	"	33 K
R17	" -333	"	33 K
R18	" -333	"	33 K
R19	" -333	"	33 K
R20	–	–	
R21	QRD161J-105	CR	1 M
R22	" -103	"	10 K
R23	" -105	"	1 M
R24	" -471	"	470
R25	" -223	"	22 K
R26	" -223	"	22 K
R27	" -152	"	1.5 K
R28	" -471	"	470
R29	" -221	"	220
R30	" -222	"	2.2 K
R31	" -102	"	1 K
R32	" -681	"	680
R33	" -681	"	680
R34	" -392	"	3.9 K
R35	" -221	"	220
R36	" -102	"	1 K
R37	" -222	"	2.2 K
R38	" -182	"	1.8 K
R39	" -750	"	75
R40	" -331	"	330
R41	" -332	"	3.3 K
R42	" -224	"	220 K
R43	" -562	"	5.6 K
R44	" -223	"	22 K
R45	" -102	"	1 K
R46	" -222	"	2.2 K
R47	" -123	"	12 K
R48	" -123	"	12 K
R49	" -821	"	820
R50	" -221	"	220
R51	" -103	"	10 K
R52	" -223	"	22 K
R53	" -223	"	22 K
R54	" -103	"	10 K
R55	" -221	"	220
R56	" -750	"	75
R57	" -562	"	5.6 K
R58	" -223	"	22 K
R59	" -103	"	10 K
R60	" -183	"	18 K
R61	QRD161J-103	CR	10 K
R62	" -222	"	2.2 K
R63	" -222	"	2.2 K
R64	" -222	"	2.2 K
R65	" -222	"	2.2 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description
R66	QRD161J-222	CR	2.2 K
R67	" -222	"	2.2 K
R68	" -222	"	2.2 K
R69	" -222	"	2.2 K
R70	" -103	"	10 K
R71	" -103	"	10 K
R72	" -563	"	56 K
R73	" -472	"	4.7 K
R74	" -472	"	4.7 K
⚠ R75	" -222	"	2.2 K
R76	" -103	"	10 K
⚠ R77	" -222	"	2.2 K
⚠ R78	" -222	"	2.2 K
R79	" -472	"	4.7 K
R80	" -472	"	4.7 K
R81	" -103	"	10 K
R82	" -103	"	10 K
R83	" -332	"	3.3 K
R84	" -473	"	47 K
R85	" -473	"	47 K
R86	" -472	"	4.7 K
R87	" -103	"	10 K
R88	" -103	"	10 K
R89	" -103	"	10 K
R90	" -103	"	10 K
R91	" -103	"	10 K
R92	" -103	"	10 K
R93	" -103	"	10 K
R94	" -103	"	10 K
R95	" -103	"	10 K
R96	" -104	"	100 K
R97	" -473	"	47 K
R98	" -103	"	10 K
R99	" -103	"	10 K
R100	" -472	"	4.7 K
R101	" -472	"	4.7 K
R102	" -472	"	4.7 K
R103	" -472	"	4.7 K
R104	" -102	"	1 K
C 1	QET61HR-225	E Cap	2.2 50 V
C 2	QET61AR-476	"	47 10 V
C 3	QET60JR-227	"	220 6.3 V
C 4	" -227	"	220 "
C 5	QET61AR-476	"	47 10 V
C 6	QET61HR-225	"	2.2 50 V
C 7	QET60JR-476	"	47 6.3 V
C 8	QET60JR-108		1000 6.3 V
C 9	QET61AR-476		47 10 V
C10	" -336		33 "
C11	QET61CR-106	"	10 16 V
C12	" -336	"	33 "
C13	QET61AR-476	"	47 10 V
C14	QET61CR-336	"	33 16 V
C15	" -106	"	10 "
C16	QET61AR-476	"	47 10 V
C17	QEN61HM-105	NP Cap	1 50 V
C18	QEN61CM-106	"	10 16 V
C19	QEE51CM-475	T Cap	4.7 "
C20	" -475	"	4.7 "
C21	QCF31HP-223	C Cap	0.022 50 V
C22	" -223	"	0.022 "
C23	" -223	"	0.022 "

Symbol No.	Part No.	Part Name	Recommended Part/ Description
C24	QCF31HP-223	C Cap	0.022 50 V
C25	" -223	"	0.022 "
C26	" -223	"	0.022 "
C27	QCS31HJ-221	"	220 P "
C28	" -221	"	220 P "
C29	QFN31HK-222	MY Cap	0.0022 "
C30	" -102	"	0.001 "
C31	QCS31HJ-391	C Cap	390 P "
C32	QFN31HK-472	MY Cap	0.0047 "
C33	" -472	"	0.0047 "
C35	QET40JM-107	E Cap	100 6.3 V
C36	QCF11HP-103	C Cap	0.01 50 V
L 1	PU48530-220J	Coil	22 μH
L 2	" -101K	"	100 μH
L 3	" -6R8J	"	6.8 μH
EQ 1	PU31933-5	Equalizer	
CF 1	PU51190	Ceramic Filter	
CF 2	PU54060	"	
	PU43351-5	Cap. Housing	11–15
	" -9	"	21–29
	" -2	"	31–32
	" -2R	"	41–42
	" -4	"	51–54
	" -4R	"	61–64
	" -3	"	71–73
	" -5Y	"	81–85
	" -7	"	91–97
	" -3R	"	101–103
	" -4	"	111–114
	" -3	"	121–123
	" -3R	"	141–143
	" -2	"	151–152
	" -3	"	161–163
	" -2Y	"	171–172
	" -2R	"	181–182
	" -3Y	"	191–193
	" -6	"	211–216
	" -4Y	"	221–224
	" -3	"	231–233
	" -3R	"	241–243
⚠	PU54059	Heat Sink	
	PU45375-3	Transistor Spacer	
	PU41624-6	Isolation Washer	
	LPSP3006ZS	Screw	
	DPSP3006ZS	"	

8.2.24 P.B. Chroma Amp. Board Ass'y 2 5 . PU33776A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	MB84066BM	Integrated Circuit	
IC 2	BX6012	"	
D 1	MA150	Diode	
D 2	"	"	
D 3	"	"	
R 1	QRD181J-102	CR	1 K
R 2	" -102	"	1 K
R 3	" -102	"	1 K
R 4	" -102	"	1 K
R 5	" -332	"	3.3 K
R 6	" -102	"	1 K
R 7	" -102	"	1 K
R 8	QRD181J-104	CR	100 K
R 9	" -221	"	220
R10	" -103	"	10 K
C 1	QFN31HJ-392	MY Cap	0.0039 50 V
C 2	" -392	"	0.0039 "
C 3	" -392	"	0.0039 "
C 4	QCS31HJ-390	C Cap	39 P "
C 5	QFN31HJ-333	MY Cap	0.033 "
C 6	QET61AR-476	E Cap	47 10 V
C 7	QFN31HJ-333	MY Cap	0.033 50 V
C 8	" -153	"	0.015 "
C 9	QET61HR-105	E Cap	1 "
C10	QFN31HJ-333	MY Cap	0.033 "
L 1	PU47051-122	Coil	1.2 mH
L 2	" -122	"	1.2 mH
L 3	" -122	"	1.2 mH
L 4	PU48530-390J	"	39 μH
L 5	PU47051-222	"	2.2 mH
LPF 1	PU50747	Filter	
LPF 2	PU52646	"	
EQ 1	PU48515	Equalizer	
	PU43351-2	Cap. Housing	11–12
	" -4R	"	21–24
	" -4	"	31–34
	" -3Y	"	41–43
	" -3	"	51–53
	" -2	"	61–62
	" -2R	"	71–72
	" -2Y	"	81–82
	PU54567	Shield	
	PU51779	PWB Holder	

8.2.25 Switch Board 2 6

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU53881	Circuit Board	
	QSL2318-008	Lever Switch	REC SELECT SW
	QSL0011-001	"	SYSTEM SELECT SW
	SSSP2604Z	Screw	

8.2.26 Terminal Board Ass'y 2 7 .... PU54166A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
D001	–	Vas Wire	
R001	QRD182J-750	CR	75
R002	" -221	"	220
C001	QET61AR-107	E Cap	100 10 V
	PU50766	Test Pin	TP1

8.2.27 Cassette Photo Interrupter Board 2 8

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51618	Circuit Board	
PI-03	GP1L02	Photo Interrupter	
	PU43351-106	Cap. Housing	1–6

8.2.28 Junction Board 2 9

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51868-1-4	Circuit Board	
	PU43351-2Y	Cap. Housing	61–62
	" -2R	"	71–72
	" -2	"	81–82
	" -2	"	91–92
	" -3R	"	101–103
	" -3Y	"	111–113
	" -3	"	121–123
	" -4	"	131–134
	" -7	"	141–147
	" -12	"	151–162
	" -2	"	211–212

8.2.29 Tuner/Timer Sub Board Ass'y 3 0 PU10432D3

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ Q205	2SD1211R	Transistor	
⚠ Q206	2SC1983	"	
Q207	2SB644R	"	
⚠ Q208	2SC1983	"	
Q209	2SD639R	"	
D231	RD6.8EB1	Zener Diode	
D232	10E2FA-8	Diode	
D233	HZ24-3L	Zener Diode	
D234	10E2FA-8	Diode	
D235	1SS133	"	
D236	HZ7A-1L	Zener Diode	
D237	"	"	
D238	MA27TA	Diode	
D239	1SS133	"	
R281	QRD161J-223	CR	22 K
R282	" -220	"	22
R283	–	–	
R284	QRD161J-223	CR	22 K
R285	–	–	
R286	QRG019J-470	OMR	47 1 W
⚠ R287	QRZ0054-100	FR	10 1/4 W
R288	QRD161J-123	CR	12 K
R289	" -682	"	6.8 K
R290	–	–	
R291	–	–	
R292	QRV144F-3602	MFR	36 1/4 W
R293	QRV147F-103S	"	10 K "
R294	QRD161J-473	CR	47 K
⚠ R295	–	–	
R296	–	–	
⚠ R297	PU52108-330K	Posistor	33
R298	QRV3507-222	VR	2.2 K (30 V REG.)
R299	QRD167J-681	CR	680
C251	QFN31HK-103	MY Cap	0.01 50 V
C252	" -332	"	0.0033 "
C253	" -153	"	0.015 "
C254	" -103	"	0.01 "
C255	QET61HR-105	E Cap	1 "
C256	QET61JR-107	"	100 63 V
C257	QCF32HP-103	C Cap	0.01 500 V
C258	QET61VR-476	E Cap	47 35 V
C259	–	–	
C260	–	–	
C261	QCF32HP-103	C Cap	0.01 500 V
C262	QET61JR-107	E Cap	100 63 V
C263	QET61HR-106	"	10 50 V
C264	QFN31HK-103	MY Cap	0.01 "
C265	QET61HR-105	E Cap	1 "
C266	PU51954	Gold Cap	3.3 F 5.5 V (Back-up)
C267	QET61AR-227	E Cap	220 10 V
C268	QET61HR-105	"	1 50 V
L251	PU49993-102 or PU49994-102	Coil	1 mH PU49993-102

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠ T201	PU52134-2	Heater Trans.	
	PU54427	SHADE	
	PU50597-2	Cap. Housing	111–112
	PU43351-7	"	121–127
⚠	PU51951	Heat Sink	for Q206
	PU45375-3	Spacer	"
	PU41624-6	Isolation Washer	"
	SBST3010ZS	Screw	

8.2.30 Relay Board 3 1

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU51866-1-3	Circuit Board	
	PU43351-102	Cap Hausing	31–32
	" -102Y	"	41–42
	" -102	"	171–172
	" -102	"	181–182
	" -102R	"	191–192
	" -10	"	201–210

8.2.31 Mix Booster Board Ass'y 3 2 .... PU10432C5

Symbol No.	Part No.	Part Name	Recommended Part/ Description
⚠	PU49720-2M	Mix Booster	

8.2.32 Video Sub Board Ass'y 3 3 ...... PU33748A

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	M51454L	Integrated Circuit	
IC 2	MB84066BM	"	
IC101	VC2011	Integrated Circuit	
Q 1	2SC2021Q,R,S	Transistor	2SC2021S
Q 2	2SB641Q	"	
Q 3	–	–	
Q 4	2SC2021Q	Transistor	
Q 5	2SC2021Q,R,S	"	2SC2021S
Q 6	2SC2021Q	"	
Q 7	2SC2021Q,R,S	"	2SC2021S
⚠ Q 8	2SB641S	"	
Q101	2SC2021Q,R,S	Transistor	2SC2021S
Q102	"	"	"
D 1	1SS133	Diode	
D 2	"	"	
D 3	"	"	
R 1	QRD161J-122	CR	1.2 K
R 2	" -821	"	820
R 3	" -392	"	3.9 K
R 4	" -222	"	2.2 K
R 5	" -391	"	390
R 6	" -392	"	3.9 K
R 7	" -391	"	390
R 8	" -391	"	390
R 9	" -471	"	470
R10	" -471	"	470
R11	QVZ3244-222	VR	2.2K (NOISE CANCEL)
R12	QRD161J-223	CR	22 K
R13	" -223	"	22 K
R14	" -272	"	2.7 K
R15	" -223	"	22 K
R16	" -333	"	33 K
R17	" -102	"	1 K
R18	" -561	"	560
R19	–	–	
R20	QRD161J-683	CR	68 K
R21	–	–	
R22	QRD161J-472	CR	4.7 K
R23	" -182	"	1.8 K
R24	" -391	"	390
R25	" -152	"	1.5 K
R26	" -152	"	1.5 K
R27	" -102	"	1 K
R28	" -152	"	1.5 K
R29	" -392	"	3.9 K
R30	" -182	"	1.8 K
R31	" -391	"	390
R32	" -102	"	1 K
R33	" -152	"	1.5 K
R34	" -102	"	1 K
R35	" -152	"	1.5 K
R36	" -104	"	100 K
R37	" -104	"	100 K
⚠ R38	" -152	"	1.5 K

Symbol No.	Part No.	Part Name	Recommended Part/ Description	
R39	QRD161J-103	CR	10 K	
R101	QRD161J-123	CR	12 K	
R102	" -103	"	10 K	
R103	" -102	"	1 K	
R104	" -331	"	330	
R105	" -102	"	1 K	
R106	" -153	"	15 K	
R107	" -103	"	10 K	
R108	" -223	"	22 K	
R109	" -221	"	220	
R110	" -222	"	2.2 K	
R111	" -333	"	33 K	
R112	" -332	"	3.3 K	
R113	" -101	"	100	
R114	" -152	"	1.5 K	
C 1	QET61AR-476	E Cap	47	10 V
C 2	QET61HR-105	"	1	50 V
C 3	QCS31HJ-101	C Cap	100 P	"
C 4	QCF31HP-223	"	0.022	"
C 5	QET61AR-476	E Cap	47	10 V
C 6	QCS31HJ-151	C Cap	150 P	50 V
C 7	" -220	"	22 P	"
C 8	QET61AR-476	E Cap	47	10 V
C 9	QET61HR-105	"	1	50 V
C10	QCF31HP-103	C Cap	0.01	"
C11	" -103	"	0.01	"
C12	QCS31HJ-820	"	82 P	"
C13	QET61AR-476	E Cap	47	10 V
C14	" -476	"	47	"
C15	–	–		
C16	QCS31HJ-680	C Cap	68 P	50 V
C17	QET61AR-476	E Cap	47	10 V
C18	QCS31HJ-121	C Cap	120 P	50 V
C19	" -220	"	22 P	"
C20	" -560	"	56 P	"
C21	PU51163-181	"	180 P	
C22	" -151	"	150	
C23	QCF31HP-223	"	0.022	50 V
C24	QCS31HJ-820	"	82 P	"
C25	" -330	"	33 P	"
C26	PU51163-181	"	180 P	
C27	" -161	"	160 P	
C101	QET61AR-476	E Cap	47	10 V
C102	QCS31HJ-680	C Cap	68 P	50 V
C103	" -330	"	33 P	"
C104	" -331	"	330 P	"
C105	QET61AR-476	E Cap	47	10 V
C106	QCF31HP-223	C Cap	0.022	50 V
C107	QEN61AM-476	NP Cap	47	10 V
⚠ L 1	PU48530-101K	Coil	100 μH	
L 2	" -330J	"	33 μH	
L 3	" -391J	"	390 μH	
L 4	" -121J	"	120 μH	
⚠ L 5	" -101K	"	100 μH	
⚠ L 6	" -101J	"	100 μH	
L 7	" -121J	"	120 μH	
⚠ L 8	" -101J	"	100 μH	

Symbol No.	Part No.	Part Name	Recommended Part/ Description
L101	PU48530-180J	Coil	18 µH
⚠ L102	" -101K	"	100 µH
LPF 1	PU53474	Filter	
LPF 2	PU53348	"	
EQ 1	PU53475	Equalizer	
EQ 2	PU53349	"	
	PU43351-6	Cap. Housing	(11–16)
	" -3	"	(21–23)
	" -3	"	(31–33)
	" -5	"	(41–45)
	" -2	"	(51–52)
	PU50766	Test Pin	TP1, TP-GND

8.2.33 Servo Power Transistor Board $\boxed{3}\boxed{4}$

Symbol No.	Part No.	Part Name	Recommended Part/ Description
	PU52289-2	Circuit Board	
⚠ Q11	2SD3890	Transistor	
	PU41624-6	Isolation Washer	for Q11
	PU45375-3	Transistor Spacer	"
	SBST3008ZS	Screw	
	PU43351-3	Cap. Housing	1–3

8.2.34 Remote Control Board Ass'y UR52VPB2

Symbol No.	Part No.	Part Name	Recommended Part/ Description
IC 1	M50115AP	Integrated Circuit	
Q 1	2SD637Q,R	Transistor	2SD637R
Q 2	2SB822Q,R	"	2SB822R
D 1	MA150	Diode	
D 2	SE303A or TLN105	LED (Infrared)	SE303A
D 3	SE303A or TLN105	"	"
D 4	BR3432S	LED	
R 1	QRD141J-222	CR	2.2 K
R 2	" -223	"	22 K
R 3	" -270	"	27
R 4	" -102	"	1 K
R 5	" -180	"	18
R 6	" -1R2	"	1.2
R 7	" -1R2	"	1.2
R 8	" -270	"	27
C 1	OET61CR-107	E Cap	100 16 V
C 2	OCS31HJ-101	C Cap	100 P 50 V
C 3	" -101	"	100 P "
CF 1	CSB455EB1	Ceramic Filter	
J 1	M0JB7V	Jack	